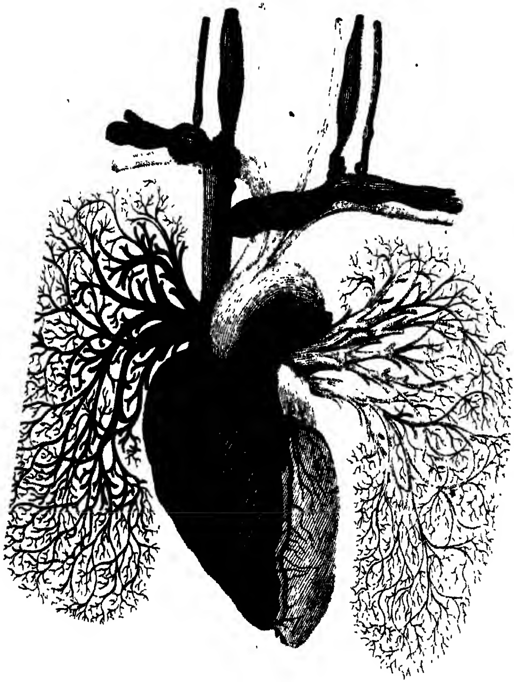

THE

EDINBURGH SCHOOL

OF

MEDICINE;

CONTAINING THE

PRELIMINARY OR FUNDAMENTAL BRANCHES

OF

PROFESSIONAL EDUCATION,

VIZ.

ANATOMY, MEDICAL CHEMISTRY, AND BOTANY.

Intended as an

INTRODUCTION TO THE CLINICAL GUIDE:

THE WHOLE FORMING A COMPLETE SYSTEM OF MEDICAL
EDUCATION AND PRACTICE ACCORDING TO THE
[illegible] [illegible] OF THE EDINBURGH SCHOOL.

BY WILLIAM NISBET, M.D.

FELLOW OF THE ROYAL COLLEGE OF SURGEONS OF
EDINBURGH, &c.

IN FOUR VOLUMES.

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THE

CHEMICAL GUIDE;

OR, A

VIEW

OF THE

MODERN PRINCIPLES

OF

MEDICAL CHEMISTRY, AND PHARMACY;

ACCORDING TO THE ARRANGEMENT OF THE LATE DR. BLACK;

WITH

THE PHARMACEUTICAL PREPARATIONS

OF

THE LONDON AND EDINBURGH COLLEGES.

TO

DR. WILLIAM SAUNDERS,

FELLOW OF THE ROYAL COLLEGE OF PHYSICIANS OF LONDON, &c. &c.

THIS Work, that details the Principles of a Science in which his Knowledge is eminently conspicuous, is addressed, as a proper Tribute to his Character and Talents, by

THE AUTHOR.

PREFACE.

THE present volume, which contains the principles of Medical Chemiſtry, may be conſidered as divided into two parts. The firſt, or largeſt diviſion, is compoſed from the Lectures of the late Dr. Black, introduced into this form, with the modern additions made to them, to adapt them to the uſe of the Student according to the preſent ſtate of Chemical Science. In preſerving the valuable collection of facts which diſtinguiſhed the leſſons of this illuſtrious Chemiſt, we conceive we are rendering a ſervice of the higheſt utility to the intereſts of Science; for, if publiſhed, as originally delivered by him, with the obſolete theory, the Student would find it difficult to reconcile the difference of opinions with modern reaſoning, and derive leſs advantage from their peruſal than in their preſent form. The arrangement, therefore, of Dr. Black

has been ſcrupulouſly preſerved; and to the end of each Claſs we have ſubjoined a view of the Medical Effects of the different Subſtances that compoſe it in one connected detail.

In this part we have had occaſion to treat, at large, the various Airs as Medicines, and to appreciate their relative importance.

In the ſecond claſs, Mineral Waters form an important detail. Under the Salts, the late introduction of the Acids as anti-venereal remedies has been fully reviewed; and, in the Metals, the ſame conſideration of their Medical properties has taken place.

The principles of Vegetable and Animal Subſtances, and the functions of the Animal ſyſtem, have received equal attention.

In the laſt part, or Pharmacy, is introduced the mode of exhibiting all the remedies of the former claſſes, or diviſions; and to the Pharmacopœia's of the two Colleges are added the exhibition of Airs and the artificial Preparation of Mineral Waters. We have conſidered ourſelves not at liberty in the firſt part to alter the manner of Dr. Black, but have ſcrupulouſly adhered both to his ſtyle and expreſſion, for which no apology is, ſurely, neceſſary. To this illuſtrious chemiſt the modern diſcoveries

may be confidered as owing. The difcovery of the firft of the gafeous bodies, or carbonic acid gas, fo eminently his own, led the way, and required only an extenfion of what his well-conducted experiments firft fuggefted.

On the whole we flatter ourfelves, that the prefent volume, with the feparate Pharmacopœia's of the Clinical Guide, will abundantly detail what is neceffary for the Student to know on the fubjects of Medical Chemiftry and Pharmacy.

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CONTENTS.

HISTORY

OF

CHEMISTRY.

I.

CHEMISTRY is that ſcience which contributes more than any other, to the utility, the ornament and pleaſure Society.

II.

its comprehending all the effects of heat, light, air, a mixture on bodies, its ſubject includes every ſubſtance wh form renders it capable of being acted upon by theſe powers. Hence it takes in almoſt the whole of creation, and from the nature of its ſubject, an ultimate knowledge of the ſcience can never be attained, nor the reach of its diſcoveries bounded.

III.

The origin of Chemiſtry, like that of all the other ſciences, is obſcure, that many parts of it muſt have been very early known cannot be doubted. In their natural ſtate numerous bodies are expoſed to the effects of heat, light,

air, and mixture: and though the principles of these effects or changes could not then be explained, yet mankind, from repeatedly examining such effects, would naturally be led to imitate them, and by accident would sometimes attain what they aimed at. Thus, a foundation for many parts of this science, would come to be very early laid. There is therefore no need for endeavouring to support its antiquity, as authors have done, by any fanciful proofs, a contested point which involves no real utility.

IV.

In pursuing the History of Chemistry the circumstances necessary to be attended to are,

1st, The different views of its followers at different periods, and which led of course to a different state of the science.

2dly, The celebrated persons by whom these different states were produced.

And, 3dly, The periods of time as connected with the general history of mankind, when these different states or revolutions in the science took place.

V.

Proceeding then on this plan, three different periods fall to be remarked in the History of Chemistry, at each of which a considerable change in its views occurred.

VI.

The first of these periods extends from its origin, or from the first accounts of the science, until the time when, presuming on the power of their art, chemists attempted a transmutation of the baser metals into gold, which became for long the favourite object of this science.

VII.

The second period to be remarked is from the time

chemists, laying aside this idea as impracticable, applied their attention to medicine, and attempted the discovery of a Panacea, or universal remedy.

VIII.

The third period commences from the time that chemists failing likewise in this favourite object, Philosophy came to be introduced into the science, which moderating the views of its followers, gave it a new face, such as it wears at the present day, when it is dedicated to the improvement of the essential and ornamental parts of life.

IX.

These then are the chief periods to be fixed in the History of Chemistry, and those celebrated authors fall next to be mentioned to whom the science is chiefly indebted for the alterations which took place in it at these periods, and who therefore in studying the subject deserve principal regard.

X.

The author or name to be noticed at the commencement of the first period, is the Hermes or Mercury of the Egyptians, who is reputed to have taught many of the arts to that people; and the conclusion again of this period was marked by the name of Friar Bacon; for though a number of others preceded him, yet none of them have been so celebrated as this last author.

XI

The second extends from Roger Bacon to the age of Paracelsus, who may be said properly to have been the first medical chemist, and to whom we certainly owe the introduction of many powerful remedies.

XII.

The third is from Paracelsus to about the commence-

ment of the present century, which we shall mark by the name of the great Sir Isaac Newton.

XIII.

The fourth is from the time of Sir Isaac Newton to the present day, which we shall close with the name of the illustrious and unfortunate Lavoisier, who may be considered in chemistry as having created a new science.

XIV.

Of the first, or what we may term the casual state of chemistry, little is to be depended on. That some arts were early known, there can be no doubt; but on this chemists, to support the antiquity of their science, have presumed a great deal; conjecture has supplied the place of history, and, if we can credit authors, most of the great men who flourished in antiquity, were more or less adepts in this kind of knowledge; the traces of it, however, to one who impartially peruses the subject, are very faint. It appears indeed that metallurgy, or some notion of the separation of metals from their ores was very early known; that the tinging different stuffs with colours, or the art of dying, had also made some progress; and that even the making of glass, was an art not unknown in the days of Pliny; but still this amounts to very little, when tracing the History of Chemistry as a science; and even those few arts that were known, we may judge would be in a very rude state at that period.

XV.

Chemistry then may be said to have taken its first regular form at what we have marked as the second period of its history, when the object of its professors came to be the transmutation of the baser metals into gold. This æra may be named properly the Superstitious State of Chemis-

try. It began about the time of Conſtantine the Great; and indeed we have no writers upon it any higher than the period of the tranſlation of the Roman Empire to Conſtantinople. For though the metallurgic part of chemiſtry, as we obſerved, is found very ancient, and moſt of the firſt writings on the ſcience are confined to this diviſion of it, yet it was not until this late period that alchemy became its profeſſed object. The firſt author who wrote expreſsly on this art is Julius Maternus Firmicus, and ſoon after him Æneas Gazæus, who mentions it as a proceſs, the ſucceſs of which was then beyond diſpute. To the firſt cultivators of this ſcience, indeed many of the changes that took place on matter, during their operations, would appear aſtoniſhing: hence they would be liable to overrate the power of an art, whoſe principles were yet in their infancy. They lived too in an age when ſuperſtition tainted every department of ſcience, and when the mind, viſionary and wild, runs generally from one extreme to another, without purſuing the ſober tract of philoſophical inveſtigation. It would appear that chemiſts at this time, though unſucceſsful in this attempt of tranſmutation, had yet inculcated the univerſal belief that they were poſſeſſed of the means of doing it. Hence, we find a decree of the Emperor Diocleſian, that all the writings of the chemiſts of Egypt ſhould be burned; which country had at that time rebelled againſt his government By this means he ſuppoſed the Egyptians would be deprived of their knowledge of preparing gold, and then be rendered unable to ſupport the expences of war. To confirm this, the writings alſo publiſhed by the chemiſts were generally in a language peculiar to themſelves, and this affected obſcurity encreaſed the apparent value of their con-

tents. The theory at this time, on which they proceeded, was that gold was the only perfect metal, that the others were only essays towards it, which required a finishing hand, and which they therefore, in imitation of Nature, attempted to accomplish. In doing this, though it appears they missed their aim, yet they certainly fell on several great discoveries, and which, instead of rating as they should have done, they considered only in a secondary light, or as so many steps towards their success in their favourite pursuit. The value indeed of most subjects, on which we have bestowed much labour and attention, we are apt to estimate too high, and to consider probabilities as too nearly allied to realities. Thus we find that even the philosophical mind of Mr. Boyle, and also Boerhaave himself, was not proof against this weakness. They both consider the power of chemistry as adequate to the formation of gold. Even later, an English Physician Dr. Price pretends to have actually succeeded in the experiment, and that before a number of most creditable witnesses. But as his experiment was never carried farther than in the small pamphlet he wrote, and as it said that, before his death, which happened soon after, he repented of what he had published, we have every reason to infer there must have been some fallacy in the case. At any rate we may conclude that, after the experiments of so many ages, we have yet no process for procuring this change; and if any chemists have accidentally succeeded in any instance, as they pretend, they have never yet brought it to that perfection as to render it universal.

XVI.

From this superstitious or alchemical period of chemistry, we proceed to the next or the medical. Until the

introduction of chemistry into medicine, the remedies employed were few in number, and at the same time simple in their nature. On its introduction a remarkable revolution arose to which many circumstances contributed. The æra of this revolution may be placed about the year—— for though many chemical medicines were employed by the Arabians, as we find from the names of them still retained, yet, until this period, or the age of Paracelsus, medical chemistry did not become general. The circumstances which contributed to render this revolution so remarkable were,

1st. The progress of anatomy detecting the errors of the ancient phisiology, on which the theories of the schools were formed: and, secondly, the appearance of certain new diseases at this time, resisting the efficacy of the Galenical practice.

XVII.

The author to whom we are indebted for the first of these, was Vesalius. This anatomist, the greatest of his age, by substituting the human subject in the place of the quadruped, the common anatomical victim of these days, publicly detected the errors of Aristotle and Galen, whose reputation on medical subjects had been hitherto deemed infallible in the schools. The veneration for antiquity being thus shaken, a revolution was easily effected; for the venereal disease being at this time brought from America, and every where spreading its devastations, the physicians were unable to check its progress by the use of the common Galenical remedies. It was here the genius of Paracelsus shewed itself. Being acquainted with the properties of mercury, which it is said he had learnt from an eminent surgeon of that time, named Carpi, he

boldly applied it in the cure of this disease, and that with such success as to become the first practitioner of his day. Opium also he got acquainted with; and by the use of these two very active medicines, with a bold and daring hand, he effected cures surprising in an age when the remedies employed, if not weak and inert of themselves, were at least rendered so by the small quantities, in which, according to the Galenical practice, they were exhibited. Naturally of a heated imagination, his success with these medicines, in the diseases to which they were properly applied, carried him too far, and he expected, by means of chemical remedies, to remove every malady to which the body is subjected. With this view, a chemical theory of medicine came to be introduced by him; but in spite of his boasted Panacea, which was to answer every purpose, and with which he promised to extend his own life to at least a hundred years, Paracelsus died at an early period. Succeeding chemists, we find, enter into his views, in their attempts at an universal medicine; and Van Helmont goes so far as to promise even an antidote against fate. It must be confest, however, that to the chemists, although thus visionary in their ideas, a knowledge of many powerful remedies is owing; and from this time until very lately, physicians came to be divided into two sects, the Galenical and Chemical; the former adhering to the old opinions of the school, and the latter embracing the new doctrines of chemistry.

XVIII.

But though we thus allow the merit of chemistry to have been great, in leading us to an acquaintance with many powerful remedies, yet the connection of its principles with physic, has certainly, on the whole, been a prejudice to the latter.

For, 1ſt.—By the introduction of chemiſtry into medicine, a wide field was opened for empyriciſm from the facility with which remedies were invented, and at the ſame time their nature concealed: And, 2dly. The action of every remedy being explained on chemical principles, thoſe powers which regulate the animal œconomy were loſt ſight of, and the operation of the vital principle ſubjected to the laws of inanimate matter; and it is only within theſe few years that the chemical tenets of medicine have been exploded, though an attempt is now made to revive them in a new form.

XIX

We come now to the third and laſt æra of chemiſtry, or what we have termed the Philoſophical. Hitherto its profeſſors were occupied ſolely with the purſuit of one object, and the bounds of the ſcience were thus contracted within the narrow limits of an art. It is at this period we come to view it in a proper light, when the chimerical extravagancies of its votaries being given up, it came to be applied to the improvement of the arts, and the advantage of civil life. The æra of this change is ſo late as the year—— ; and hence it may be properly ſaid to have been the laſt of the ſciences that immerged from barbariſm, or put off the rude garb, in which it had formerly appeared, for the charms of philoſophy. The author to whom we are indebted for this change, was Bacon Lord Verulam. Fond of philoſophy, and the ſtudy of nature, he took a view of the different ſciences, obſerved the progreſs which had been made in each, and marked out what remained to be done. He ſaw that chemiſtry, however rough in her appearance, by extending her views, might be made one of the moſt uſeful branches of ſcience. His example was followed by the Honorable Mr. Boyle, who both

improved chemiſtry himſelf, and alſo with much freedom detected the errors of preceding chemiſts. Sir Iſaac Newton likewiſe contributed much to place it upon its preſent footing; and his diſcoveries have opened a way to the improvement of every department of ſcience. The univerſal taſte for literature which at this period prevailed, naturally ſuggeſted the idea of literary inſtitutions for the improvement of knowledge, and the free communication of diſcoveries; in conſequence of this, the Royal Society of London came at laſt to be eſtabliſhed: the ſame plan was ſoon followed by the French, and in the courſe of a few years, ſimilar inſtitutions became general in every country in Europe. To theſe inſtitutions has chemiſtry perhaps owed more than any of the other ſciences, and the patronage of different Princes has of late years encreaſed much the ardour for chemical purſuits. Convinced of the advantages to be derived from the cultivation of this ſcience, a liberal ſupport has been afforded to its enquiries in thoſe countries, eſpecially where minerals abound; and thus chemiſts of the firſt eminence have appeared in France, Germany, Sweden, and even Ruſſia. New diſcoveries, therefore, it is to be hoped, will daily encreaſe the value of the ſcience, and widen its circle beyond any bounds that can be ſet to it.

XX.

Such are the principal æras that deſerve to be remarked in the progreſs of chemiſtry to the preſent day; and from this view, Philoſophical Chemiſtry, or the Science in its preſent ſtate, comes to be properly divided into two departments, the Medical and Commercial: the former of which only is the object of the preſent work; and the principles of chemiſtry therefore we are to conſider here as applied to medicine alone.

INTRODUCTION.

I.

CHEMISTRY is that ſcience which, teaching the effects of heat, light, air, and mixture on bodies, detects their conſtituent principles, their qualities and combinations.

II.

For the purpoſes of ſcience, all bodies require to be arranged into certain claſſes; and this arrangement may be formed either, firſt, from their origin, which is from the Vegetable, Foſſil, or Animal Kingdoms.

2dly, Their moſt ſimple ſtate as compoſed more or leſs of elementary principles.

Or, 3dly. Their natural qualities as being ſaline, inflammable, metallic, earthy, watery and aerial.

III.

The laſt of these arrangements, as preſerving the natural connection of bodies, is to be preferred; and as all matter is retained in its natural ſtate, by a certain connection of its particles to each other, termed their coheſive attraction according to the weakeſt degree of this in each the order of their arrangement ſhould be placed viz. Airs, Waters, Inflammables, Salts, Earths, Metals.

IV.

Airs are fluids highly elastic in every degree of temperature yet known.

V.

Waters are colourless, insipid bodies possessing a disposition to unite with salts and some airs.

VI.

Inflammables are such substances as, when set on fire, burn until resolved into their constituent parts.

VII.

Salts are distinguished by their capacity of uniting, with or solubility in water, their sapidity as affecting more or less the organ of taste, and in general their want of inflammability.

VIII.

Earths are somewhat unctuous, miscible in water, but insoluble, and resisting the action of fire.

IX.

Metals are the densest and heaviest of bodies, fusible in fire, and malleable.

X.

By the principles of chemistry, then, the nature and qualities of these bodies defined (from IV. to X.) come to be detected, but previous to their application for this purpose, the general mode of action of these powers requires to be explained.

XI.

1. *Chemical Powers.—Heat.*

By heat is understood a peculiar sensation or feeling excited in our organs, arising from a particular state of the [illegible] around.

XII.

The Phenomena to be remarked in this ſtate of the bodies, is a certain motion of their particles on each other, which continues ſo long as the feeling they impreſs remains.

XIII.

This ſtate which bodies acquire, poſſeſſes always a tendency to leave them, or to communicate itſelf to thoſe contiguous; and this communication produces at laſt an equilibrium between the ſurrounding bodies, which gives to the whole an equal temperature.

XIV.

This temperature to which bodies return, when heat forſakes them, or when they are incapable of exciting in our organs the ſame ſenſation as before, we term bold.

XV.

Cold ſeems the original ſtate of bodies, and though many arguments have been uſed to ſupport, on the contrary, its activity by the exiſtence of certain particles, termed Frigorific, yet, as there is no cauſe from which cold proceeds, but the bare abſence of heat, and as their frigorific particles appear rather a particular arrangement of the particles of certain bodies, under peculiar circumſtances, the proofs of it adduced are inconcluſive.

XVI.

By cold is underſtood every degree of temperature, inferior to our own, and which is incapable of exciting the ſame ſenſation communicated by heat; but as bodies of the ſame degree of temperature excite oppoſite ſenſations in different individuals depending on this degree of their own temperature, ſo cold ſeems only an inferior degree of heat, meaſured by our own feelings. Hence, accord-

ing to the degree of thofe oppofite fenfations, excited in ourfelves, we judge of the various degrees of temperature prevailing in bodies.

XVII.

Since heat then, from what was obferved, difcovers always a tendency to leave bodies, we muft conclude that it is not their natural ftate, but a property acquired, and the different means of acquiring it may be referred to the head of motion, mechanically, or chemically excited.

XVIII.

From a confideration of the caufes inducing heat, two theories refpecting its nature at prefent prevail, termed the Mechanical and Chemical. The former fuppofing it to confift folely in a certain rapid motion of the particles of the bodies upon each other. The latter, as depending on a peculiar elaftic matter originally prefent in them, but rendered active by motion.

XIX.

Adopting the latter of them, heat may be defined "A fubtle, elaftic fluid, the particles of which, in proportion as they poffefs a ftrong attraction for the particles of other bodies, difplay a repercuffency or repulfive difpofition between their own;" and this fluid is termed caloric, or the matter of heat.

XX.

This difpofition is difcovered by the effects of heat, which on all bodies are pretty fimilar, and confift in their expanfion, fluidity, vapour, and inflammation.

XXI.

Expanfion.

Expanfion is an encreafe of the bulk of bodies propor-

tioned to the encreafe of the matter of heat, and which fuppofes their confequent contraction or return to their natural ftate on its removal.

XXII.

All bodies appear under three diftinct forms of *Solid*, *Fluid*, and *Elaftic Fluid*. According, then, to the different cohefion of their particles, the quantity of this expanfion differs with the fame temperature in different bodies, the proportion being lefs in the firft, greater in the fecond, and moft of all in the laft, though the exact degree of it in each have not yet been precifely afcertained.

XXIII.

According to the nature of the bodies, and the different purpofes alfo for which it is intended this effect of heat fhould be differently induced, for in thofe of a rigid and inflexible kind, the fudden application of it by acting partially occafions their rupture, and the fame occurs to a heated body fuddenly reduced in its temperature by the application of cold, yet in fome cafes, where a fudden contraction of the expanded body is required, this procedure is neceffary.

XXIV.

Though expanfion is thus the general effect of heat, and contraction, on the contrary, arifes from cold, yet in certain cafes, where by the change of temperature a new body is formed, expanfion is produced by the latter. Thus water, when formed into ice, is more bulky in its parts, and iron, and fome other metals acquire, on cooling, a more expanded form, in confequence of their changing into a more brittle ftate.

XXV.

By the expanſion, however, which bodies receive from the power of heat, nothing is added to their weight ... is in thoſe particular caſes where they receive an evident change of their original texture. Thus metals turned to aſhes weigh heavier than when in the form of the metal.

XXVI.

But though bodies receive no additional weight from this effect of heat, a conſiderable difference in regard to their ſpecific denſity in their relations to each other is produced.

XXVII.

It is from this effect of heat on bodies, that different attempts have been made to aſcertain its encreaſe or diminution, in a more accurate manner than can be done by the ſtandard of our own temperature or the feeling it conveys. Theſe are termed Thermometers, and conſiſt of different fluids encloſed in a tube accurately formed in its dimenſions, or capacity, and hermetically ſealed. Theſe fluids have been either ſpirit of wine, mercury or linſeed oil.

XXVIII.

In the conſtruction of thermometers, three circumſtances are neceſſary to be attended to, in order to render them accurate.

1ſt. The firſt is, that the containing ſubſtance or tube be formed of a matter receiving the impreſſion of heat equally in every part; and that the fluid alſo ſhould be viſible in it; and for this purpoſe glaſs is preferred.

2d. The ſecond is, that the fluid employed ſhould be eaſily and regularly expanded; and mercury is with this view more generally employed.

3d. And the third is, that the excluſion of air, or the vacuum be complete on introducing the fluid, and that no evaporation afterwards take place

XXIX.

With attention to theſe circumſtances, the thermometer is formed by firſt eſtabliſhing certain fixed points, in order to form a regular ſcale. Theſe points are three, the point of melting ſnow, the point of boiling water, and the intermediate point of temperature, betwixt theſe two. Theſe points being once eſtabliſhed, all the other gradations can be eaſily ſettled.

XXX.

A thermometer ſo conſtructed may be truſted as meaſuring with accuracy the regular ſtandard of heat in bodies, to the extent of the points ſpecified, but beyond theſe the uſe of thermometers is limited, as in very high degrees of heat an irregularity in the expanſion of the fluid takes place, by which high degrees of heat cannot be meaſured by it, neither is the thermometer able to aſcertain the proportion or intenſity that one heat bears to another.

XXXI.

The firſt of theſe defects, or the meaſure of high degrees of heat, is ſupplied by calculation. Thus a red hot iron being taken from the fire, and allowed to cool until the thermometer can be applied to it, if the degree of heat then preſent in it is meaſured, and the exact time aſcertained it required to arrive at that point or degree, a calculation of its former heat may be made.

XXXII.

The thermometers of different countries are formed on various scales; and, in order to be acquainted with these scales, the thermometer is to be tried by fixing the three points formerly specified. The thermometer most commonly used in Britain is that of Farenheit, which, between the points of boiling water, and melting snow, is divided into 180 degrees; but later discoveries having carried the degree of cold farther than the point of melting snow, a descending series is also marked of 32 degrees, which is termed below nought.

A smaller thermometer is also in use, having its points fixed at that of melting snow, and of animal heat, the intermediate gradations being divided into 64 degrees, and the point of animal heat fixed at 96.

XXXIII.

Fluidity.

Every degree of heat capable of exciting the particular sensation described, (XI.) produces expansion, but fluidity the next effect of heat, occurs only in a certain high degree of it, and is always to be considered as a certain consequence of its presence.

XXXIV.

This degree necessary to produce fluidity, varies much in different bodies. Every degree, however, below, or in which the body retains its solid form, is termed the Point of Congelation. When the heat again is thrown in, to a certain degree, so as to loosen the cohesion of its particles, and occasion their consequent softness, it is named the

Point of Mollification; and when actual fluidity begins, it is called the Point of Liquefaction.

XXXV.

Every body, however denſe, may, by the action of heat, be reduced to a fluid ſtate, and on the contrary every fluid however rare, may, by cold, acquire a ſolid form; for the difficulty of giving ſolidity to certain fluids, appears to depend on the difficulty of extricating their latent, or original heat, termed their Combined Caloric, which, according to their rareneſs, requires a more continued and intenſe application of cold.

XXXVI.

The effect of this fluidity on bodies, on the removal of the ſenſible heat or free caloric inducing it, conſiſts in producing in them a ſtate of fuſion, vitrifaction, and ſcorification. By the firſt of which is underſtood, when bodies diſplay the ſame appearance on congealing they formerly poſſeſſed. By the ſecond, when they are changed by it into a matter reſembling glaſs. And by the third, when they form merely a compoſition of the original matter.

XXXVII.

Vapour.

From fluidity, by a ſtill higher degree of heat, bodies are next converted into vapour, or an elaſtic fluid, rarer and lighter than air; and when reduced again in their temperature below this degree, they return to their natural ſtate.

XXXVIII.

This degree, termed the Vaporific Point, is different in different bodies, and is not ſo ſteady as that of lique-

faction; for, independent of heat, pressure seems likewise to have an influence on this change. Thus, in proportion to its application, bodies are capable of bearing a greater degree of heat; and as it is taken away, they are sooner converted into this state. This difference also, or degree of the vaporific point, depends on the nature of the bodies themselves, and the capacity they possess of receiving this alteration. Hence, a division of them from the degree of heat requisite for converting them into vapour, has been made into the volatile, and fixed, in the former, the conversion being easy in the latter from their greater solidity, more difficult.

XXXIX.

The theory on which the generation of vapour termed boiling or ebullition depends, has much divided the opinions of chemists. We suppose it to arise from the accumulation of such a quantity of sensible heat or free caloric, that no more can enter without converting the fluid receiving it into vapour, and the lowest parts of the fluid receiving this conversion first, they naturally ascend, or are thrown up to the surface with violence, which successively takes place until the whole is exhausted.

But besides this, certain circumstances occur in the process which shew that, independent of the sensible heat, or free caloric, an accumulation of latent heat, or combined caloric, also takes place, and enters into the vapour as an ingredient in its composition, being again extricated on the bodies returning to a different form This appears by no encreafe of heat apparently taking place after ebullition begins, though a considerable time elapse before the process is finished, and by ebul-always taking place at the same degree, whatever

the form of the vessels in which the conversion into vapour is made.

XL.

This change in general requires, we observed, a higher degree of heat than that necessary to fluidity; and all bodies however fixed may be volatilized or receive this form. The change is always to be understood as the consequence of heat, either sensible or latent; for, independant of the application of sensible heat, that is, of caloric either free or combined, all bodies, from the possession of their latent quantity, or free caloric, or combined caloric, are constantly receiving a dissipation of their more volatile parts; and this is particularly the case in those substances in which the volatile parts are in great abundance.

XLI.

Hence, a division of vapour may be made into the partial or spontaneous, and into the elastic, or general; the former being performed in a gradual, slow manner, and insensibly taking place; the latter being quick in its operation, and having the same action on every part of the substance, which it displays by its total dissolution.

XLII.

The former, or spontaneous, is particularly exemplified in the case of volatile bodies, which constantly emit an effluvia, and also in water, in which a constant evaporation on exposure takes place; and this evaporation appears inelastic, and is confined entirely to the surface; hence, the larger the exposure, the greater this evaporation is experienced to be. It is to this cause the origin of damps and fogs is to be attributed. The presence of the sun occasioning this spontaneous evaporation, which is again

on its abſence, converted into this particular form. By this alſo, the cauſe of hoar-froſt may be explained, and the human body alſo, from the ſame ſpontaneous evaporation, is enabled to bear the exceſſive heat of warm climates. The ſurrounding atmoſphere is tempered by the evaporation of its fluids, and a cauſe thus oppoſed to that exciting the animal heat within; and it is perhaps the want of this evaporation that occaſions the exceſſive heat in fever, in conſequence of the conſtriction of the ſkin, and the leſſened diſcharges which attend it.

XLIII.

The elaſtic evaporation again depends on the application of ſenſible heat or free caloric; and this application receives various denominations, according to the purpoſes intended, or the different volatility of the ſubſtances ſeparated. Thus, when the volatile parts are ſeparated, and again condenſed into a ſolid or fluid form, this proceſs is termed Sublimation and Diſtillation. When the fixed parts only are preſerved, it is termed Evaporation and Uſtulation.

XLIV.

Ignition.

After vapour the next effect of heat that falls to be mentioned is Ignition. This effect is univerſal, and all bodies undergo this change, even the moſt elaſtic, if their elaſticity is capable of being confined.

XLV.

The exact degree at which this change takes place, is more uniform than that of all the other effects of heat, and in all bodies it is the ſame; but this degree can only

be ascertained by calculation, for it goes beyond the limits of the thermometer to settle it.

XLVI.

Different degrees of this effect of heat, are taken notice of both by chemists and mechanics, as melting red hot, melting when beginning to be red hot, and melting after being red hot, also a cherry red, a worm red, &c. and there is no doubt that this effect of heat can be encreased to a considerable degree beyond bare ignition: in this it differs from ebullition, which remains always the same.

XLVII.

now with accuracy these different degrees which ires, in order to produce on bodies its general have hitherto been considering, we shall next enumerate them, as stated by Farenheit in his thermometer.——*Vide* Farenheit's Scale.

XLVIII.

Inflammation.

The last, though a less general effect of heat than any of the former, is Inflammation. It is an effect confined to a particular set of bodies, or the inflammable, and this effect in them is attended also with certain changes, different from all other bodies, which receive from heat no permanent alteration, and only communicate it to the bodies around.

XLIX.

The phenomena of inflammation in such bodies consist on their being once heated, in its continuing and acquiring strength, so that they give out much light and

heat to thofe around. When this effect comes to ceafe, they then appear, on examination, changed in their nature to a fubftance fimilar to other kinds of matter, and the fource of light and heat, they formerly poffeffed no longer exifts.

L.

This matter, into which they are changed after combuftion, varies in different bodies. The fpirit of wine is changed into water, fulphur into a falt, and others into an earthy matter, &c.

LI.

The caufe of this peculiarity of inflammable bodies depends on their ftrong attraction for vital air, in a certain temperature, and their combination with it, which occafions the production of all the phenomena of combuftion, and the fubfequent changes that enfue.

LII.

This peculiarity of inflammable bodies is also the foundation of other properties they poffefs, that it generally encreafes their difpofition to fluidity, and volatility; and in many bodies which [illegible] is a lefs degree, [illegible] to convey inflammability, it gives [illegible] properties.

LIII.

The degree of heat neceffary to produce this effect on bodies, varies in different cafes, but a certain degree of it is always neceffary, and along with this alfo, the contact of the inflammable body, with the atmofphere, and even the frequent renewal of the latter, are effential circumftances, in order to its fufficient abforption of vital air.

LIV.

Thus we have traced the general effects of heat, or that power which is the chief internal cause and principle of activity in the universe. Its presence we find every where. By it the principal operations of nature are carried on. From the ocean the water is raised by it, which descends again in the form of rain, in order to support all animal and vegetable life. To the latter it gives the power of attracting nourishment, which it refines in the different parts of the vegetable, so as to make it assume the different forms, which its different forms take; and when its influence departs, the decay and death of their structure ensues. To animal life it is equally necessary; by it alone the evolution of the egg is enabled to take place, and that independent of the female at all. When the [illegible] is afterwards complete, the same dependence [illegible] is also necessary for its support, and when this [illegible] is removed, [illegible] torpor, and insensibility occur, [illegible] cease until the [illegible] expire. This is a common [illegible] northern countries, where extreme cold pre-[illegible]

Thus the face and appearance of nature, the very form which the different parts of it assume, depend upon the nice adjustment by which heat is regulated. Water also, which we see in so many beautiful forms, moving with fluidity and transparency, when regarded with a philosophical eye, we find also employed in the most extensive operations of nature, pervading the most interior parts of the earth, necessary to the protection of various minerals, stones, and earths, assisting in bringing their different ingredients together, and making them concrete. When we examine it farther, in the form of vapour, we

fee it rife from the furface of the ocean to form clouds, which defcend in rain on the land; on other occafions, thefe clouds form fnow, to protect the vegetables from intenfe and mortal cold; and after this change, by the heat of fummer, it returns to its former ftate, and defcends to promote vegetation, and to bring every thing to maturity. Such is its multiplied and extenfive ufe, when fet on motion, and directed by the nice adjuftment of that heat, which attends the return of day and night, of fummer and winter, and which occafions alfo the different forms it affumes in different parts of the globe; for the proper heat being withdrawn, it acquires a folid appearance, and becomes unfit for the various operations defcribed. On the other hand, if the heat exceed its due degree, it is changed into vapour, and thus the folid parts of the globe, would be confounded; and by the mixture of air, water, fmoke, and vapour, the original chaos would take place.

LV.

2. *Light.*

The 2d chemical power we enumerated after Heat, is Light.

By Light we underftand that fenfation or feeling impreffed by radiant bodies on our organs, which occafions the perception of fight.

LVI.

The phenomena remarked in fuch bodies producing light are, that it is projected from them in every direction; that it is reflected in right lines, and diverges in proportion as it proceeds from its fource; that it is emitted with inftantaneous velocity; that it becomes inflected as it paffes near any fubftance; and that when it fully enters it, it fuffers refraction.

LVII.

By this fenfation of light, we are enabled to diftinguifh the prefence of bodies, and to divide them, as opake, tranfparent, and coloured. This depends on the different rays of light, and the various modifications they receive when applied to bodies.

LVIII.

The different rays of light, or primitive divifions of it, are demonftrated to be feven; red, orange, yellow, green, blue, indigo, and violet; the firft being the leaft refracted, and the others refrangible in their order. Hence, it is to the different combinations of rays, reflected from the furface of bodies, that all the different fhades of colour are owing.

LIX.

The general fource of light we find to be combuftion or attrition, and from this is inferred its fuppofed connection with heat; but that a diftinction takes place between them appears,

1. Becaufe heat, as in fire, is not proportioned to the light it gives:

2. Light is often fugitive, but heat is always more permanent:

3. Heat, with accefs of air, produces combuftion; light has often an oppofite effect.

LX.

The effects of this power are important, and chiefly difplayed on Vegetation.—To it the colour and odour of vegetables is to be greatly attributed; and it likewife exalts in a high degree their powers in other refpects. Thus plants growing in the fhade are pale, and without color.

Thus the warmer climates afford productions of more exalted ſmell and taſte. By light vegetables are enabled to pour out torrents of pure air, and to correct the ſtate of the atmoſphere which ſurrounds them. To chemiſtry its effects are equally important. There is not a ſubſtance but receives ſome alteration from its expoſure to light; alterations which have not as yet been ſufficiently attended to, but which open a wide field for future reſearch.

LXI.

3. *Air.*

The 3d chemical power to be noticed after Heat and Light is Air, a power of univerſal agency, and which owes the detection of its general influence to modern diſcovery. As the conſideration of this power occurs in almoſt every proceſs, and as the whole of chemiſtry depends on the extrication or fixation of this fluid, it is improper to enter into any farther detail of it here.

LXII.

4. *Mixture.*

From the conſideration of theſe different chemical powers, we proceed to examine the laſt, or Mixture.

The effects of mixture on bodies, are more varied than thoſe of heat, and are therefore leſs capable of being reduced to a general application.

LXIII.

The firſt effect of mixture is, its being attended either with union, or without union; and this union is either ſlowly and gently performed, or with heat, agitation, and even violence.

This union is either of two fluid bodies together, or at

other times of a folid and fluid. It is alfo attended either with active folution, or merely diffufion; the fluid body being termed the folvend, or menftruum, and this folution in the latter, or menftruum, only takes place to a certain proportion of the folid body, which is termed faturation.

This faturation is of two kinds, the fimple and the reciprocal, which refer to the proportion of combination that takes place.

LXIV.

But bodies thus mixed, we occafionally wifh again to feparate, and to do this the two powers required are, heat, and the addition of a third body.

With refpect to heat, the degree of it required is often different on the mixture from what it was on the feparate fubftance.

In regard to the addition of another body, when the mixture has confifted of a folid and fluid, the feparation from the one falling down in a folid form, is termed precipitation, and the body occafioning this, precipitant.

But though precipitation is thus made with the folid body firft united, a mixture may be formed anew, with the fame folvend, by the addition of another folid body, and the fame thing may be fuccefsfully repeated on every precipitation.

LXV.

Another effect of mixture is, the difference of bulk in the aggregate, from their feparate ftate. For the moft part the bulk is lefs, though at times it is otherwife. Hence, a judgment cannot be formed of the proportions

of the ingredients, from the ſpecific gravity of the particulars.

LXVI.

These effects of mixture deſcribed, naturally ſuggeſt the neceſſity for ſome theory or explanation. This was firſt attempted on mechanical principles, and conſidered to depend on the ſize and ſhape of the particles of the bodies, and their being kept ſeparate, or in a ſtate of fluidity by agitation and motion. This theory, firſt ſuggeſted by Lord Verulam, was ſtrongly reaſoned on by Mr. Boyle, and later chemiſts. After this followed the theory of diffuſion, or ſuſpenſion of ſolids in fluids, from the minuteneſs of their particles. The ſpecific attraction of the particles of bodies for each other, was then ſuggeſted by Sir Iſaac Newton, a theory the moſt ſimple, and conformable to the other parts of nature. To this ſpecific attraction, in order to a complete explanation, may in certain caſes be alſo joined the extrication of an elaſtic aerial matter, and likewiſe the latent heat of bodies aſſuming a ſenſible form.

LXVII.

This ſpecific attraction differs from affinity, which is by no means an appropiate term, though preferred by ſome French chemiſts. It differs alſo from all the other ſpecies of attraction, and does not, like that of large maſſes of matter, diſpoſe them to adhere in the leaſt, but occaſions a moſt exquiſitely minute diviſion of the particles of the ſubſtances mixt.

LXVIII.

In order to the ſucceſs of this ſpecies of attraction, it is neceſſary that at leaſt one of the bodies be either fluid

or difpofed to fluidity; by means of which ftate the two are brought into clofer contact, and this fluidity is produced in different bodies according to their nature, by means of folution, fufion, or evaporation.

LXIX.

The firft of thefe, or Solution, is favoured by,

1ft, Mechanical divifion of the body, fo as to extend its furface for the action of the fluid, or to encreafe the fphere of its attraction:

2d, Agitation, fo as to encreafe the proportions of the body capable of folution, or to extend the limits of faturation:

3d, Heat, which encreafes the powers of folution, until the vaporific point, when the body is changed to a different form; and the feveral modes of its application with this view confift in,

a. Digeftion, or a gentle heat promoting the action of the parts on each other:

b. Circulation, or the raifing the more volatile parts, which are again condenfed, and mix with the general mafs.

c. Cohobation, or the pouring the liquor back after condenfation, into the original mafs.

LXX.

When a third body is added in cafes of mixture, and a preference is difplayed in the attraction, by one of the bodies leaving the other to unite with this third, this preference is termed Elective Attraction.

LXXI.

To explain this preference, the fame principle of attraction is referred to; but this preference is not fufficien

for a full explanation, and a repulsion between the third body added, and the body separated in the form of precipitation, must also be supposed to take place.

LXXII.

It is by this power of elective attraction that many compounds come to be decomposed, which otherwise could not be effected. This subject was first systematically attended to by Geofery, who formed a table of such attractions. It has been enlarged and perfected by succeeding chemists. By this systematic knowledge of the special attraction of bodies, the chemist is enabled to foresee what will occur in his experiments, and to reason upon it in a certain degree.

LXXIII.

Besides this elective attraction, or new combination of a single compound, another degree of it occurs in cases where two compounds are divided, and two new combinations formed, termed the Double Elective Attraction. The knowledge of this is equally necessary as the former, and its principles are at times very difficult to explain.

LXXIV.

II. *Chemical Apparatus.*

We have thus considered the several powers, or agents in chemistry, and it is next proper to examine the manner in which these powers are employed, or act, in order to produce the different changes on bodies, which chemistry effects.

LXXV.

This division consists in a detail of the chemical apparatus, and this apparatus may be reduced to three heads; the vessels in which the effects are to be performed; the

fuel, or means of producing heat; and the furnaces, or manner of applying it.

LXXVI.

Vessels.

The variety in the first is, in their materials and form; and with respect to their materials, chemical vessels should be possessed of the following qualities:

1. Transparency to enable us to mark the changes going on:

2. Resistance to the action of corrosive or active substances.

3. Endurance of sudden alterations of heat and cold:

4. Strength to confine elastic vapours or steams:

5. Incapacity of being melted by great heat:

No material however is to be found possessed of all these qualities. Hence, vessels must be formed of the most suitable materials that can be had, adapted as much as possible to the special purpose or operation for which they are applied; and the best materials to be had for the different purposes of chemistry are, glass, metal, and earthenware.

LXXVII.

Glass possesses the first quality, viz. Transparency. To give it the third, or the power to resist sudden changes of temperature, it must be made as thin as possible of a spherical figure, and well annealed or gradually cooled in the making it. With these requisites, and of the flint kind, which is preferable when much strength is not necessary, and when great changes of heat and cold do not suddenly take place, it is the best material.

LXXVIII.

Metal poſſeſſes no other of the requiſites enumerated, but the third and fourth. Its tendency to corroſion by acids, particularly when of iron or copper, may be ſomewhat counteracted by lining it. If the common lining is not ſufficient, it may be done with ſilver or gold.

LXXIX.

Earthen ware, the laſt material requiſite for the purpoſes of chemiſtry, ſhould have in its formation a proper toughneſs and firmneſs; but, except the reſiſtance to heat, it does not poſſeſs any of the other qualities enumerated. To render it therefore more uſeful for different chemical purpoſes than in its natural ſtate, ſeveral additions are made to it in its formation; as,

1ſt, Fine ſand reduced to powder is mixt with it:

2d, Black lead is alſo mixt with it:

3d, The clay itſelf is prepared by burning it, and reducing it to a fine powder, and then mixt with the raw material:

4th, Porcelaine, or the finer ſpecies, is ſubſtituted, or elſe a mixture of glaſs and porcelaine, which is formed by putting a glaſs veſſel into an earthen one, then ſurrounding it with ſand and clay, and filling it with the ſame; when expoſing it to the heat of a potter's furnace, it acquires the nature of porcelaine.

LXXX.

From the materials we proceed next to the form of the veſſels, which is entirely regulated by their uſe; and, in order to underſtand this, the variety of the operations muſt be conſidered; and as the ſeparation of ſubſtances from one

another is effected by their solubility, fusibility, and volatility, the vessels fall to be examined as adapted to these purposes.

LXXXI.

The vessels adapted to fusion are crucibles, which are of two kinds, the sand and clay, and the black lead. The former is best fitted for the fusion of acrid and saline substances, the latter for the metallic. Their form is made wide at top, and they gradually taper to the bottom. Their top is generally cornered, or formed into three angles, for the ease of pouring out their contents, and they are covered with a top to prevent extraneous substances or fuel falling in. When used, they are placed on a pedestal or piece of brick to prevent the cold affecting their bottom, or to preserve them of an equal temperature in every part. To give this vessel a greater power of resisting heat, a double crucible is employed at times, having its interstices filled up with sand. When the fusion requires little heat, instead of the crucible it may be done in an iron pot, or even a glass vessel.

LXXXII.

The vessels adapted to convert bodies into vapour fall next to be examined; and that operation is performed in three different ways:

By evaporation or ustulation, when we dissipate the volatile parts in order to retain the fixt parts:

By distillation or sublimation, when the volatile parts are retained and condensed; and

By cementation, when the parts are only reduced into vapour, in order to act on each other.

LXXXIII.

The veſſels for the firſt of theſe operations, or evaporation, are open, of various materials, according to the nature of the ſubſtances to be wrought upon. All ſubſtances of a corroſive or ſaline matter, require the materials of glaſs; thoſe of a metallic nature of metal, particularly iron; they ſhould be of a globular form, and a part of them cut off at the top, ſo as to leave a good deal more than half the globe. When the humidity of the ſubſtance is wanted to be evaporated without injuring its other parts, porcelaine or earthen ware is preferred, ſet upon the top of an iron veſſel containing water, the ſteams of which only act upon the bottom part: when a violent heat again is wanted, a crucible anſwers for this operation. Various inſtruments have been alſo invented for this proceſs of evaporation, which act by blowing ſhowers of air through the liquor, ſo as to convert it, with as little expence as poſſible, into ſteam; the ſame plan is uſefully employed in diſpelling taint from liquors, particularly from water, by means of a machine reſembling a gardener's watering pan, to which a pair of bellows are affixed, and made to ſend the air through the fluid.

LXXXIV.

The veſſels for diſtillation, or the production of ſpirits, come next in order. After this proceſs the matter remaining is termed a Reſiduum; and when of a black hue or colour, a caput mortuum.

This proceſs is conducted in three different ways; per aſcenſum, deſcenſum, and per latus. To theſe varieties, therefore, the veſſels are ſuited.

LXXXV.

In the firſt the vapour aſcending is forced down. This mode is uſed only in a very few caſes, as the diſtillation of oil of cloves, and in procuring mercury and zinc from their ores.

The ſecond ſpecies of diſtillation is moſt common, the vapour being allowed to aſcend to ſome height, and then to take its way downwards into a cold cavity to be condenſed; and the veſſel moſt commonly uſed for this purpoſe is the common copper ſtill. The improved form of it conſiſts of the body containing the materials, and the head into which the vapour immediately ariſes; from the middle of the top of this iſſues a pipe which is directed to a ſide, and deſcends again in order to be inſerted into the extremity of another pipe which deſcends into a large veſſel of copper, containing a quantity of cold water. On deſcending into the veſſel it then paſſes obliquely along the bottom of the oppoſite ſide, where it iſſues out, and where the veſſel receiving the condenſed matter is applied to it.

LXXXVI.

Inſtead of the ſtill, when the matter to be diſtilled is ſmall, and of a corroſive nature, the cucurbit and alembic is preferred, or as the vapour is ready to act upon the material uſed as adjoining at the ſide, the retort and receiver anſwer, but which occaſions the diſtillation to take place per latus: in doing this, there is only one point to be ſecured, which is not expoſed directly to the ſteams when condenſed. The receiver ſhould be of the conical ſhape, as giving moſt room for the circulation of the ſteam and for extracting the ſubſtances collected in the veſſel.

As noxious vapours are apt to arife in many operations, on the introduction of fome of the fubftances, various ways of overcoming this inconvenience have been attempted by altering the conftruction of the receiver. Thus it is made lutilated, or with a hole at top; but this renders the heat unequal; and it is preferable therefore formed with a plug or ftopper; it has been alfo made with a hole in the fide, fhut up with a ftopper, fo as to occafionally, by opening it, let out the fteam and examine the odour; but in general it is fufficient to make the lute fo tight as to confine only thofe fteams that are capable of condenfation, and a little hole may be made in it for allowing the more elaftic ones to efcape. But befides a hole, receivers have been alfo made with a pipe iffuing from the fide, termed fpout receivers, for quickly carrying off the more volatile parts, though they are little ufed. To this apparatus belongs another part named the adapter, being alfo a receiver, with a pipe from its farther extremity intended to be fitted or adapted into another receiver, and fo on until a ftring of them is formed for the more effectual condenfation of the fteams.

LXXXVII.

To encreafe the power of the retort in refifting heat, it receives at times a coating of clay or other materials, to about a quarter of an inch thick, which retains the veffel together, in cafe of cracks. For different operations retorts require to be made of the fame materials as crucibles, and even occafionally of iron.

LXXXVIII.

From the form of the retort the introduction of liquors into it becomes difficult without touching its fides; to avoid

this therefore, a funnel, termed the retort funnel, is requir-ed; and this is introduced ſo far as to put the matter into the body of the retort, and upon drawing it out it is kept applied to the upper part of the retort, while the drop hangs from the under part.

LXXXIX.

The veſſels for ſublimation are leſs varied and nume-rous than thoſe for diſtillation. The crucible and capital are occaſionally employed; and in the great number of common caſes a ſmall apparatus is ſufficient, conſiſting of an oblong glaſs veſſel, the lower part of which is heated, while the other part is kept cool. In conſequence of this, the ſteams ariſe and form a cake or ſublimate upon the upper part of the veſſel; and this is ſeparated by cut-ting the veſſel in two. In place of this apparatus ſome-times the retort and receiver anſwer well. The retort muſt have a ſhort neck, that the ſublimate may not plug it up, and the elaſtic ſteams endanger its burſting. The long form of the receiver is alſo preferable to the globular for the eaſe of taking out the condenſed matter. For this proceſs, aludils were formerly much in uſe, being a ſet of receivers placed over one another, and below hav-ing an earthen veſſel, the bottom of which can be made red hot. Thus the ſteams are raiſed to any height, and according to the condenſibility of the fuſe, they occupied a higher or lower ſituation in the receivers, the top being terminated by an alembic.

XC.

The veſſels for cementation next occur, an operation ſo called from the manner in which the materials are diſ-poſed. It is generally performed in a crucible, and the

ſubſtance to be changed by this proceſs is placed ſo, that an alternate layer of it, and of the material producing the change, takes place. Inſtead of a crucible, when large quantities of matter are ſubjected to this operation, as in the converſion of iron into ſteel, a chamber is fitted up in the furnace to anſwer this purpoſe.

XCI.

The veſſels employed in making mixtures and promoting ſolutions are next to be detailed; a common glaſs or porcelaine one is ſufficient, if there is no great volatility, or any violent conſequence to attend the application of the bodies to each other. Where ſuch violence or ebullition occurs, inſtead of theſe common veſſels, the phial achemica, or matraſs with a cylindrical neck, is preferred. When the quantity of the matter is ſmall, a ſmall veſſel of the ſame form as the florentine flaſk will do. Where the heat is raiſed high in order to promote the action of bodies upon one another, the neck of the matraſs requires often to be larger, or to have another veſſel applied to it to receive the ſteams and give room for condenſation, which condenſed matter will fall back; and this proceſs is termed circulation.

XCII.

Connected with ſolution falls to be examined Papin's digeſtor. It is generally made of copper, very thick and ſtrong, broad at top, with a lid fitted to it, which applies very exactly. There are two projections on the ſides in order to make the lid go on in a particular manner: but they are unneceſſary. There are then two projections to which may be fitted the two holes of a croſs bar; and in the middle of it there is a ſtrong ſcrew, by which the lid can

be preſſed down very ſtrongly. By this machine water is made to bear a much ſtronger heat than in the ordinary preſſure of the atmoſphere. It is provided too with an apparatus for letting out the ſteam, if it ſhould be in danger of burſting the veſſel. A pipe is made through the lid, which is fitted with a valve, upon which preſſes a lever at a very ſmall diſtance from the center of its motion; and this can be made to preſs upon the valve with different weights, according to the diſtance at which theſe weights are placed from the center.

XCIII.

To ſolution belongs alſo the apparatus for filtration of the matter remaining undiſſolved. To do this with a powdery ſubſtance, we allow it to ſettle, or the depuratio per ſubſidentiam to take place; and it is beſt in a cylindrical veſſel, or the liquor may be paſſed through a bibulous paper, which keeps back the ſmalleſt duſt or impurity. It is folded in a particular manner, and placed in a funnel, in order that the liquid may paſs through.

Under this head, may be alſo enumerated the different means of facilitating ſolution by mortars, ſieves, files, hammers, &c. which encreaſe the ſurface.

XCIV.

Means of producing Heat.

From the veſſels we come to the ſecond diviſion of the chemical apparatus, or the different means of producing heat.

Theſe may be arranged under ſeven different heads, viz. The principle of animal heat; friction or percuſſion of hard bodies againſt each other; electricity; the mixture of certain bodies with each other; fermentation and putrefaction; the ſun's rays; and, laſtly, fuel.

XCV.

The first, or power which the animal system possesses of generating heat, is only employed in chemistry, in regulating thermometers; and this degree of heat in healthy persons, is found pretty much uniform.

The second, or percussion of hard bodies against each other, is very transitory in its effect, and is applied chiefly to the kindling of gun-powder, but it is of little use in chemistry, and cannot be applied to large quantities of matter.

The third, or electricity, is perhaps superior to any heat that can be produced, and often very singular and circumscribed in its effects; it is of no importance in chemistry, and therefore does not merit a particular consideration.

The fourth, or the mixture of certain bodies, produces only a transient heat, and is more to be noticed as producing cold, or a diminution of it. Thus several salts dissolved in water produce it, but particularly nitre and sal ammoniac, mixed with three times the weight of water. By this mixture the temperature may be reduced to 20° of Farenheit. But a still greater degree of cold may be produced by a mixture of ice and sal ammoniac, so as to bring down the mercury to the beginning of the scale, and by surrounding the vessel with wool, flannel, or fur, this cold may be continued for a long time. But a mixture of ice and snow with the nitrous acid acts still more powerfully than the former mixture; and a cold may be thus produced to 148° of Farenheit below frost.

The fifth, or fermentation and putrefaction, are a power-

ful means of generating heat, which is alfo lafting and eafily procured. It is ufed for promoting vegetation, and alfo in Egypt for hatching of eggs, as related by Rameaur. In chemiftry it is employed to promote the converfion of various liquors into vinegar ; for the putrefaction of urine to make phofphorus ; and it is applicable wherever a long continued gentle heat is required. Horfe dung and oak bark can maintain a heat to 120° of Farenheit; the former fooneft arrives at heat, but it is alfo fooneft exhaufted, as in a month ; the latter is more gentle and lafting, continuing fome months. Much depends on the quantity of the fubftance for the proportion of the heat, and the degree of humidity, which may be encreafed fo far from the laft circumftance, as to break out in fire.

The fixth, or fun's rays, is equal to the former in degree, and from being a dry heat, it is applicable to feveral other purpofes, particularly the drying of vegetables, when the colour is of little confequence ; but this heat, by encreafing the denfity of the rays, by means of a mirrour or looking glafs, may be encreafed to a degree as to diffolve and convert into fmoke the denfeft metals. Many projects have been propofed to conftruct thefe veffels with ftill greater perfection, particularly by Mr. Buffon.

XCVI.

The feventh and laft means of producing heat is by fuel, which is the moft frequently employed, and the variety in the effect of fuel depends on the various nature of the fuel itfelf, and upon the management and command of the inflammation. The variety and the nature of fuel may be reduced to four kinds.

1ſt, Inflammable fluids.
2dly, Peat or turf.
3dly, Wood or foſſile coal in its charred ſtate ; and,
4thly, Wood or foſſile coal in its crude ſtate.

XCVII.

The firſt, or inflammable fluids capable of burning on a wick, are chiefly ſpirit of wine and oil ; they give the moſt equal heat, but cannot be employed to any great extent. The force of the heat depends on the ſize and number of wicks, upon which the fluid burns, and the equal manner with which they are fed ; ſpirit of wine is preferable to oil, as being more manageable, burning with a gentle heat, which may be raiſed the length of 174° of Farenheit ; it is alſo perfectly free of any extraneous matter or ſoot.

Oil, from being much diſpoſed to emit ſoot, does not communicate the heat ſo quickly as ſpirit of wine ; and to obviate this, two methods have been fallen upon ; the employing a ſmall flame or candle ; but as it ſcorches the wick, and has leſs power of ſucking up the oil, ſo the flame is gradually diminiſhed or the making a wick of aſbeſtos, a ſubſtance compoſed of fibres reſembling flax, but which can be thrown into the fire without ſuſtaining any injury ; but ſtill the oil evaporating from the wick, leaves a quantity of extraneous matter behind, and hinders the oil from being ſucked up. No other remedy then remains, but frequently changing the wick, which however varies the ſtrength of the flame.

XCVIII.

The ſecond, or peat, is a light ſpungy ſubſtance, inca-

pable of producing violent heat, and consuming fast. Its denser kinds when charred may be employed for a gentle heat, but in its rude state it contains so much volatile matter and water, as to occasion by exhalation much waste of its heat.

XCIX.

The third, or wood and fossile coal, in a charred state is the most useful chemical fuel. The former, or charcoal, kindles quickly, emits, when burning, few watery or other vapours to clog the operation. When consumed, it leaves few ashes; these are light and easily blown away, without any disposition to melt. The only imperfection is, its being quickly consumed.

The latter or fossile coal differs from the former, in being more slowly consumed, and in producing more intense and lasting heat. Its inconvenience lies in the quantity of its ashes, a drossy matter.

The advantage of fuel in this charred state is its privation of watery and other volatile principles, which when present, prevent its rising to a heat above 212° of Farenheit, without being apt to break the vessel containing it. These principles however exist in various proportions in different coals; and in some, as the Kilkenny coal, are hardly in any sensible quantity, for it does not emit gross vapours that give any flame, and its heat continues long before it is consumed.

C.

The use of charred substances is often attended with dangerous effects from the nature of the air they emit, nor is it less so in their crude state, though their effects are

more guarded againſt, as being conſpicuous. On expoſure to ſuch air, the firſt ſymptom felt is a ſenſe of weakneſs, which gradually encreaſes till the ſenſes are loſt, and the perſon falls down apoplectic. This ſtate is attended with a deep ſnoring ſleep, a full pulſe, inſenſibility to the objects around, with fluſhing of the face, and foam at the mouth. The treatment conſiſts, after immediate removal to a free atmoſphere, in firſt employing veneſection, then throwing cold water on the head, and applying a powerful ſtimulus to the lower extremities. In ſome caſes even the actual cautery has been ſucceſsfully employed.

CI.

The fourth, or wood and coal in the crude ſtate, give out a ſepious and vivid flame, when air is admitted to them, which renders them applicable to particular purpoſes. This flame is nothing more but the inflammable matter contained in theſe ſubſtances ſet on fire. This inflammable matter in wood and coal, in their crude ſtate, riſes in the form of oil and ſooty ſteams, which, when plenty of air is admitted, breaks out into a flame, and continues as long as the oil and ſteams aſcend. During this inflammation the principle of inflammability is conſumed, and produces the intenſe heat, ſo that the volatile matters are ſoon diſperſed through the air, and loſt. The advantage of this fuel conſiſts chiefly in the moſt violent heat being produced by it, and that in any form; but it is improper for a gentle and long continued heat, and when the fuel is added in ſmall quantity to obviate this, the heat produced cannot be regular. Any degree of heat therefore, may be raiſed with this kind of fuel, pro-

vided a ſtrong current of air is made to ruſh through the inflammable matter.

CII.

Such are the principle varieties of fuel, by which they are fitted for the different purpoſes of chemiſtry; beſides heating bodies more or leſs, they poſſeſs ſome other qualities, in conſequence of which they produce different changes upon bodies. Theſe changes depend upon ſomething added to the fuel, or upon ſomething taken from it, to be afterwards conſidered.

CIII.

Modes of applying Heat.

From the means of producing heat we proceed to the third diviſion of the chemical apparatus, or the contrivances for applying it, and by which its force is regulated. Theſe comprehend furnaces, and ſome other parts connected with them.

The principle required in the conſtruction of every furnace is,

1ſt, The confinement of the heat; and,

2dly, The proper inflammation of the body to heat it.

The firſt of theſe, or the confinement of the heat, is by means of a chamber or cavity; the ſides of which are of ſome thickneſs. This cavity is furniſhed with a door, at which freſh fuel may be put in; and it is provided alſo with a grate, for the reception of the aſhes when formed, and under this grate there is a cavity to admit the air to the fuel, and at top there is alſo an opening to allow the ſmoke or burnt air to aſcend.

CIV.

The next circumſtance in the conſtruction of furnaces

is the method of regulating the heat; and this is done by regulating the quantity of air passing through the fluid. In order to do this, it is proper to have the command of the apertures below; and this command is obtained either by the door of the ash-pit, which may be shut or opened at pleasure, or the door of the ash-pit being completely closed, a set of round holes may be formed to the number of seven or eight, which bear a certain proportion to one another.

Where a very great degree of inflammation is required, the command of the aperture above as well as below is necessary, as encreasing the height of the vent, which will add to the force of the current below.

CV.

From these general principles in the construction of furnaces, we now consider the different kinds of them as applied to special purposes; and the first to be noticed is the melting furnace. This furnace has all the parts already described. The fire place is covered with a dome from which there rises a tube to some height, and to which another additional tube may be added to the height, in all of about ten feet. The shape of the fire place is narrow below, widens in the middle, and generally contracts a little again for the sake of the form of the vessel which is put into it, and which is wider above, and by that means is equally heated: there is room above for containing a quantity of fuel, that may descend as fast as it is consumed.

A small portable furnace of this kind is very convenient for ordinary crucibles, the largest of which is only about four or six inches high, the wider part of the fur-

... may be beat out ten inches diameter, and when made of thin plate iron, and lined within, fuch furnaces are quickly heated with no great expence of fuel; but for heating large veffels, it is more proper to conftruct them of brick, when they have pretty much the fame form, only it is neceffary to make them fquare, the infide being made round by putting in a compofition of lute made of fand and clay; the top is generally made flat, and covered over with two or three bricks; the vent goes ... backwards, then is raifed up a proper height. When the veffel to be heated is very large, it is common to leave the front open for putting in the veffel, and ... it up with bricks, clay, and fand, which ... pulled down again, when the operation is

CVI

... rapidity ... inflammation is wanted, beyond what this ftructure can produce, recourfe is then had to various means of employing the air; as by the ufe of bellows of different conftructions, by which the air can be compreffed, and made to iffue with confiderable velocity; and to give them greater power, they are fometimes wrought by the force of water: but, befides this, another way in which a ftill greater effect can be produced, is by the water blaft.

CVII.

Next to the melting is the effay furnace, in the ufe of which, to fave expence, the fuel is in the inflammable ftate; and to underftand the effect of fuel in this ftate, it is proper to examine the operation of the blowpipe; it is generally made of glafs, or brafs with a large

cavity towards the one end, from which issues a small pipe perforated with a small hole not sufficient for a pin; by this a small stream of air is sent through the candle, while the cavity condenses the steam of the breath, that it may not disturb the operation. The small stream of air being more intimately mixed with the flame, and agitated with it, occasions a more complete consumption of the vapour, and makes it produce much more heat. As an improvement on this instrument, when the violent effects of heat are wanted to be investigated, a pair of bellows are used, placed under a table with a pipe, which rises through it, and to which the blow-pipe is fixed.

CVIII.

The reverberatory furnace comes next in order, and is appropriated solely to the melting of iron; it has all the usual parts of a furnace; the ash pit has a communication with the external air, and is sunk under the level of the ground; when wanted to resist violent heat, it is lined with certain materials, as a mixture of clay and sand, which has the effect of resisting bodies of a corrosive nature.

CIX.

The potter's kiln consists of a pretty large cavity, entirely filled up with columns of earthen ware, contained in a sort of cases of the same material, to defend them from being affected by the smoke, and grosser part of the flame.

CX.

The glass-house furnace is one well known, and its specialities depend upon the circumstances, that it is necessary to keep up, uninterrupted, a very violent degree of heat;

and it is necessary also, that access be given to the materials.

CXI.

The next furnaces are those employed for evaporating and digesting, and for promoting the action of bodies on each other The first of them is the common still, and it differs chiefly from the melting furnace in the situation of its vent.

The others of this kind are for heating vessels, and as the heat requires to be applied gradually, they are provided with a pot of iron into which the vessel is put, and is covered all round with sand, whereby the heat is transmitted more equally and gradually, than if the vessel was suspended over the naked fire. This is what is called the balnea or baths in chemistry.

CXII.

Digestion consists in the application of a moderate degree of heat, so as to promote the action of the several ingredients on each other; and this process is performed either by the sand bath, or where a long continued heat is required, by a particular furnace called Athanor. This last, however, has never come into general use, and does not at the same time answer with our fuel.

CXIII.

Dr. Black's Furnace.

Such are the principal forms of the chemical apparatus, but in certain arts, some furnaces of a particular construction are preferred, as in enameling, melting, and separating metals from their ores. Chemists also have attempted to adapt a furnace to all the different kinds of

operations, it being troublesome to be provided with a number. The best on this plan is that of the late Dr. Black. It is formed by joining together two thick iron plates above, and below by a thinner plate from the body of the furnace, which is of an oval form; the upper plate is perforated with two holes, the one pretty large, which is often the mouth of the furnace, and which is circular; another behind it, which is of an oval form, intended for fastening the vent to, which is screwed down upon this hole. The undermost thick plate has only one perforation near to the middle, but not altogether so, being nearer to one side of the ellipse than to the other, in which the round hole in the top is formed, so that a hole passing the center of this circular hole, has a little obliquity forwards. The ash-pit is made of an elliptical form like the furnace, and a very small matter widened, so that the bottom of the furnace goes within the ellipse, and a little below there is a border that receives the bottom of the furnace, and, except the hole of the damping plate, the parts are all closed by means of a quantity of soft lute put on, and upon which the body of the furnace is pressed down. By this means the joining of the several pieces is made quite light; for the body, fire-place, ash-pit, vent, and grate are all separate from one another, as the furnace comes from the hands of the workmen. The grate is made to apply to the outside of the lower part. It consists of a ring set upon its edge, and thin bars are likewise set upon their edges. From the outer ring proceed four pieces of iron, by means of which it can be screwed down, so it is kept out of the cavity of the furnace, and preserved from the extremity of heat, whereby it lasts much longer, and is hard-

ly indeed liable to any decay; for by being expofed to the cold air it is kept fo cool, that the iron is never deftroyed. The fides made of plate iron are luted within to confine the heat, and defend the iron from the action of it.

CXIV.

For adapting the furnace thus defcribed to the different operations of chemiftry, it may be obferved that, to form it into a melting furnace, a cover muft be provided for the opening above, which is made the door, and being immediately over the grate, this is very convenient for the introduction of fubftances that are to be acted upon, for allowing to infpect the veffel, and to take the fubftance out. This cover may be compofed of a piece of tile, or two flat fquare bricks, or a lid of plate iron may be joined, made with a rim that contains a quantity of luting. To produce alfo more heat, the height of the vent may be encreafed. This furnace can be employed in moft operations in the way of effaying. It does not admit the introduction of a muffle, but ftill it can be employed in thofe operations, where a muffle is ufed. It may be alfo ufed in calcination of lead, to convert it into litharge. Nor is it lefs ufeful in the operations for producing vapour. Where employed for fuch diftillations, as require an intenfe heat, the earthen retort is to be fufpended by means of an iron ring having three branches ftanding up from it, and which hangs down from the hole one half foot, fo that the bottom of the retort refts upon the ring, and is immediately hung over the fuel. The opening between the mouth of the furnace and retort is filled up with broken

crucibles, or pot ſherds, and theſe are covered over with aſhes tranſmitting the heat very ſlowly. It anſwers alſo for diſtillation with the naked fire, and to do this the furnace muſt be provided with a hole in the ſides, from which the neck of the retort can be made to come out, which can be eaſily again repaired. In this way diſtillations with the ſtrongeſt heat may be performed. For diſtillations again performed with retorts in the ſand bath, an iron muſt be fitted for the opening of the furnace, which is ſet on and employed as a ſand pot, while the vent of the furnace becomes the door. For this purpoſe it anſwers well, and is more eaſily kept tight than when it is in the ſides, and may be covered with a lid of charcoal and clay.

CXV.

Lutes.

The laſt part of the chemical apparatus to be conſidered is what are termed lutes, which are additional ſubſtances applied in order to cloſe the joinings of veſſels, to render them more capable of enduring heat without rupture, to change their form, or to give a coating or lining to furnaces.

CXVI.

Lutes are compoſed either of animal or vegetable matter, as clay, chalk, gum arabic, flour and water, wet ox bladder, linſeed meal, putty, &c.

CXVII.

To the uſe of lutes attention is neceſſary to prevent the burſting of the veſſels; and for this purpoſe a ſmall hole or opening ſhould be made with a pin or wire to allow part of the gas to eſcape.

CXVIII.

Of the different lutes the best is a mixture of clay and sand, in a proportion proper for standing the violence of fire. This proportion for luting is four parts of sand to one of clay; but where the inside of a furnace is to be lined, the proportion should be six or seven parts of sand to one of clay, in order to prevent the contraction of the latter. But even this is insufficient; and to render the lining more complete, clay should be used with a large proportion of charcoal dust. This is put first next to the iron, to the thickness of about an inch and an half. It must be put in very dry, in the proportion of three parts of charcoal by weight, to one of clay mixed in powder. As much water is then added as makes the powder form into balls like those of snow. These balls are to be beat with a hammer very firm upon the insides of the furnace. The other lute is then spread over it, to about the thickness of half an inch, and is beat solid upon it by a hammer, being allowed to dry slowly, that all cracks and crevices may be prevented. After the body of the furnace is thus lined, the vent is screwed on, and lined in the same manner. When once dried, which requires a long time, a fire is kindled in the furnace, which is gradually heated for a hour or two, and then raised to the greatest intensity. By this proceeding the lute becomes equally hard and solid as the furnace.

CXIX.

Such is the general view of the chemical apparatus, the proper use of which can be only learned by experience;

and a farther detail of this part will be found in most practical authors on the subject.

CXX.

III. *Particular Doctrines of Chemistry.*

Having finished the general or introductory doctrine of chemistry, by an examination of its powers, and their general mode of application, we next enter upon their particular detail, in order to a detection of the various nature and qualities of bodies.

CXXI.

To do this successfully it is necessary to establish first those general elementary principles of which all bodies are composed, at least so far as chemistry has been able to detect them, and by examining these principles, and afterwards pursuing their various combinations, the full extent of the science is attained.

CXXII.

Oxygen.

The first and most general principle in bodies, detected by chemistry, is what is termed oxygen, or the acidifying principle, a power of universal agency, and essential to three great processes, the respiration of animals, combustion, and the formation of acids; this principle is never found in an uncombined state, and it is only from its combinations with other bodies that it is obtained. Its tendency to combination is perhaps stronger than that of any other substance. It combines with every inflammable or combustible body. It does the same with all the metals. It forms a proportion of the atmospheric

air: and it composes a chief part of all vegetable and animal matter.

CXXIII.

This principle was first discovered by Dr. Priestley and Mr. Scheele, in its aeriform state, and has received from them a variety of appellations. It is procured by the application of heat from a number of substances, as,

CXXIV.

1. From the black oxyd of manganese, when exposed in an iron vessel to a red heat.

2. From the mixture of this muriat, with the sulphuric acid in the proportion of 2½ parts of the latter, and submitting the mixture in a retort to a gentle application of heat.

3. From heating nitre, red lead, or red oxyd of mercury.

4. From the exposure of growing vegetables to the action of light.

CXXV.

The effect of this principle in its combination with acids differs according to the proportion of it present in them. Thus,

1. When their bases are not saturated with it, such acids are designated by the particular termination of *ous*.

2. When a complete saturation takes place, they receive the termination of *ic*; and,

3. When they possess an excess of this principle, they are named oxygenated.

CXXVI.

The confequence of its combination with metals is alfo varied; thus,

"When no obvious acidity is produced by appearance of combuftion, the metals receive the name of oxyds, and its combination with them, *oxidation*. When an obvious calcination, or combuftion takes place, they are termed oxygenated, and the procefs Oxygenation.

CXXVII.

This principle and that of light we find always in oppofition to each other. Thus the combination of oxygen with any body produces evaporation of light, and the extrication of oxygen rarely takes place without the agency of light.

CXXVIII.

Nitrogen.

The 2d principle, equally univerfal in bodies with the former, is what has been termed Nitrogen. Like it this fubftance is never found in an uncombined ftate. It is an effential ingredient in all animal fubftances, and has received the appellation of azote and fepton by different authors.

CXXIX.

This principle, like the former, is alfo of modern difcovery. It is particularly obtained by expofing atmofpheric air, in which it abounds, to fubftances capable of abforbing or withdrawing the oxygen it contains. Thus,

a. By expofing a quantity of air in a jar to the fulphures of pot-afh, the abforption of the oxygen will foon [illegible] [illegible] [illegible] nitrogen behind.

CXXX.

2. The combuſtion of phoſphorus, or the metals in atmoſpheric air, by their abſorption of oxygen, to form a ſolid compound, will leave the azote or nitrogen in a gaſeous ſtate.

CXXXI.

This principle forms the baſe of the nitrous acid, and according to the proportion of it, combined with this baſe, and the former principle or oxygen, it is diſtinguiſhed by different appellations, or into the nitric and nitrous acids.

CXXXII.

The exiſtence then of this principle in atmoſpheric air is in the proportion of $\frac{3}{4}$ of the compound. It forms the diſtinguiſhing characters of animal matter; and it is likewiſe preſent in the vegetable kingdom.

CXXXIII.

Hydrogen.

The next of the elementary bodies is hydrogen, or that principle conſidered as the baſis of water. It differs from the two others as it may be ſaid to exiſt in nature, for it is often collected in the roofs of caverns and mines.

CXXXIV.

The diſcovery of this principle was owing to Mr. Cavendiſh, and it is eaſily procured by the decompoſition of water. Thus,

1. If water be put over iron, or iron filings, heated to ignition, a decompoſition takes place by the ſeparation of its oxygen, and abundance of hydrogen is produced.

2. The ſame effect is produced if a mixture of $2\frac{1}{2}$ parts of water, and one of ſulphuric acid be poured on either of theſe metals an efferveſcence enſues, and a copious extrication of hydrogen.

CXXXV.

Hydrogen combines with other bodies. It is a principal ingredient in animal and vegetable matter, and is particularly produced by their reſolution. It is alſo capable of diſſolving carbon, ſulphur, and ſeveral of the metals.

CXXXVI.

With this foundation of their elementary principles, we begin the detail of the different claſſes, into which the ſubjects of chemiſtry are arranged; and the firſt of them that falls to be conſidered is that of *airs*.

CXXXVII.

Claſs I. *Airs*.

The diſcovery and extent of this claſs of bodies form the great merit of modern chemiſtry. It owes perhaps its diſcovery to Boyle and Hales, its extenſion to Prieſtley and ſome others, but the proper application of it is entirely due to the celebrated Lavoiſier. It comprehends all thoſe ſubſtances which are ſo rare as to be inviſible, and this rareneſs or aeriform ſtate is to be conſidered as depending on the agency of caloric, or the matter of heat.

Where this ſtate is the effect of a high temperature, ſuch airs are termed vapors, and they return on its removal to a ſolid or fluid form. Where it takes place in a low temperature, ſuch bodies remain permanently elaſtic, and receive in common language this name.

CXXXVIII.

In their properties the ſeveral ſpecies of airs differ equally from each other, as the ſubſtances in the other claſſes of bodies; and this difference renders a diviſion of them to be made in a medical view into thoſe which are capable of ſupporting animal life, and combuſtion, and into thoſe, on the contrary, that deſtroy it.

CXXXIX.

I. *Vital Air*, (*Oxygen Gas*).

Of the former the principal is vital air, termed alſo dephlogiſticated and empyreal air; a ſubſtance deſtitute both of taſte and ſmell, but poſſeſſing in an eminent degree the power of increaſing and ſupporting animal life and combuſtion. It is heavier at the ſame time than atmoſpheric air, in the proportion of 1103 to 1000, and the latter maintains life only in conſequence of the quantity of this fluid it contains. This proportion is rated at 27 to 100.

This air changes alſo the colour of animal and vegetable ſubſtances. It is a compoſition of oxygen and caloric. Combuſtion by it, is rendered amazingly intenſe; and its powers, when urged by the blow pipe, far exceed the powers of any burning lens.

CXL.

From this body being of ſuch importance in combuſtion, a conſideration of that proceſs becomes proper here.

Combuſtion.

The chief phenomena of combuſtion are heat, motion,

flame, redneſs, and the change of the nature of the ſub-ſtance that is burnt.

The manner in which this takes place differs in its degree and appearance in different bodies, but the effect in all is the ſame, the body being no longer capable of this proceſs, and its reſidue acquiring an additional weight. This is clearly proved in bodies of a fixed nature, and the ſame alſo in thoſe that are volatile, where their product has been confined.

CXLI.

The cauſes of theſe phenomena of combuſtion, and its effects have given riſe to a variety of opinions at different periods of chemical hiſtory. M. Lavoiſier's opinion has been adopted by modern chemiſts, which conſiders this proceſs as the combination of oxygen with the inflammable body, the attraction of the latter for which only takes place at a certain temperature. Combuſtion then is ſimply a proceſs of combination. The reſidue of this proceſs is a new ſubſtance or compound, and in the formation of this compound the caloric, or matter of heat, is evolved from the oxygen as it enters into this combination.

CXLII.

The proofs of this theory reſt on four principal facts:

1. The neceſſity for the preſence of oxygen or vital air, in order to combuſtion taking place, and the rapidity of the proceſs depending on its quantity.

2. The actual conſumption of vital air in every caſe

3. The increaſed weight of the ſubſtance after combuſ-

tion, and this weight corresponding to the quantity of vital air consumed; and,

4. The actual recovery of this quantity of vital air, from the product or burnt substance.

CXLIII.

The establishment of these facts confirms the justice of the theory, and it remains to explain that evolution of light and heat which is so conspicuous during this process. It is clear of the two bodies, the oxygen and combustible substance, the former possesses the greater share of these principles, especially caloric; from the oxygen therefore this evolution of heat, or caloric, must proceed in order to accommodate its capacity or volume to that of the combustible substance, with which it is to combine; and the proof of this is drawn from two facts:

1. That the capacity of the oxygen is always greater than that of the combustible body, with which it unites:

And, 2. That the capacity of the compound is always less than that of the oxygen, though greater than that of the combustible substance, but still inferior to the capacity of the two.

CXLIV.

The extrication of l[illegible] again is considered as rather arising from the comb[illegible]body, and disengaged from it by the oxygen. T[illegible]h this point is not completely established, many circumstances render it highly probable.

II. *Foul Air* (*Nitrogen Gas*).

This air, named also mephitis and azotic g[illegible] is a substance unlike the former, being of a smell peculiar and

unpleafant. It is incapable alfo of fupporting animal life. It extinguifhes flame, and is only characterifed by its poffeffing none of the diftinguifhing qualities of the other known airs. It is lighter than common air, in the proportion of 985 to 1000. It may be confidered indeed as the refidue of common air, when vitiated by combuftion. It is eafily difengaged from animal matters, by a flight encreafe of temperature; but different parts of animals afford different proportions of it, and the concrefcible fitrous matter the moft. The proportion of it they in general afford is proportioned to their quantity of volatile alkali.

By this air delicate blue colours are flightly reddened.

CXLV.

III. *Inflammable Air* (*Hydrogen Gas*).

This air, named alfo fire damp, is peculiarly diftinguifhed by its great levity and inflammability. It is the lighteft fubftance whofe weight we are able to eftimate. When pure, it is 13 times lighter than atmofpheric air, and it immediately explodes on mixture with oxygen. It is formed by the union of hydrogen and caloric. Its lightnefs is particularly evidenced by its ufe in balloons. Plants grow in this fluid without impairing its inflammability. Water imbibes abou[illegible] part of it; and when again expelled, it is as inflam[illegible] as ever. By this addition both its bulk and speci[illegible]vity are increafed; for it occupies $\frac{1}{8}$ more fpace by its combination, and its weight is encreafed to be only $\frac{1}{10}$ lighter than common air.

CXLVI.

Thofe then are the three fimple or original gafes, from

which variouſly modified, all the reſt are produced; and the firſt of theſe productions univerſally diffuſed, and of the firſt importance to life, being what we conſtantly breathe, and by which we are ſurrounded, is atmoſpheric air.

CXLVII.

IV. *Compound Air, or Atmoſpheric Gas.*

Atmoſpheric air is a mixture of various ſubſtances in the elaſtic ſtate, for it is expoſed to the combination of all thoſe bodies which are capable of being diſengaged at the ſurface of the earth, at its common temperature. By the powers of chemiſtry this fluid, when examined, is found to conſiſt of three principal parts, vital air, azote, and carbonic acid in certain proportions. From the abundant production of inflammable air, or hydrogen gas, at the ſurface of the earth, in conſequence of the corruption or decompoſition of animal and vegetable matters, this fluid muſt alſo be generated, yet its extreme levity will naturally carry it to the higher regions, ſo that, though a part of the atmoſphere, it is placed in a ſituation beyond the examination of chemiſtry.

CXLVIII.

To a mixture then of vital and foul air with carbonic acid, the term atmoſpheric air is applied; and this mixture is in the proportion of 27 parts of vital air, 72 of foul air, or azote, and 11 of carbonic acid.

CXLIX.

The proofs of this compoſition of atmoſpheric air were firſt offered by Mr. Scheele, who found, on its expoſure to certain ſubſtances, that it ſuffered a diminution of vo-

lume, and that by this diminution it was rendered unfit for the support of life. This abstracted part therefore could not fail to be oxygen or vital air; and from this combination of oxygen, and foul air or azote, he naturally inferred that atmospheric air came to be formed. This he farther confirmed by restoring oxygen to it, in consequence of which it regained all its properties of atmospheric air. On the same subject he was succeeded by Lavoisier, who, in addition to these facts, shewed that the oxygen, or attracted part, was received by the substance producing the change, and could be often recovered again from it.

CI.

But, though the composition of atmospheric air has been thus ascertained, something still remains wanting to complete it; and this in the manner of combining by experiment its parts. Hence it is doubted whether its parts exist naturally in a state of chemical combination, or of mechanical mixture. That the latter takes place appears probable from the different proportion of oxygen which it is found to contain in the higher and lower regions; it being always greater towards the surface of the earth; and from the unlimited proportion in which these airs can be mixed, while the different matters present in the atmospheric regions may tend strongly to prevent their separation. At the same time, as a proof of its simple mixture, it is soluble in 40 times its weight of water.

CLI.

Eudiometry.

From this knowledge of the compoſition of atmoſpheric air, an attempt has been made to aſcertain its purity, or its relative capability of ſupporting animal life in different ſituations. This is effected by eudiometry, or meaſuring the exact quantity of oxygen the air contains.

CLII.

To do this it requires to add to the air ſome body capable of combining with its oxygen, and from the diminiſhed volume of air, the quantity of oxygen is inferred.

CLIII.

Different ſubſtances have been employed for this purpoſe, and each preferred by different chemiſts.

The aqueous ſolution of ſulphuret of potaſh, forms the eudiometer of Scheele, but, though complete in its operation, it is ſlow, and does not poſſeſs a criterion to ſhew when it is finiſhed. The ſame objection applies to the dry ſulphuret of potaſh, and is at the ſame time difficult to employ. The eudiometer of Volta is compoſed of hydrogen mixed with a determined quantity of air; but the hydrogen not being uniform in quality, renders it liable to error, and it is uncertain to which of the bodies the diminution is owing.

CLIV.

Nitrous gas added to any air, containing oxygen mixed

with it, will abstract the oxygen; but the result is uncertain, from the varying quality of the nitrous gas.

CLV.

The slow combustion of phosphorus over water is the most precise application of this kind, and the completion of its process is indicated by the loss of its luminous appearance in the dark, or of its surrounding cloud in day-light.

CLVI.

But eudiometry applies only to the quantity of oxygen present in the atmosphere. This fluid is rendered however unwholesome, by various other impregnations arising from effluvia, the effect of situation or season, in which the quantity of oxygen is not at all concerned. Hence it forms but an imperfect criterion of the relative healthiness of different places.

CLVII.

Atmospherical air is without taste, and for the most part without smell. It is invisible, transparent, necessary to the support of combustion, vegetation, and animal life, particularly respiration. It is absorbed in a certain quantity by water, and again expelled by boiling, or by the air-pump removing pressure.

CLVIII.

But this solvent power of air is considerable, when assisted by caloric. Hence the spontaneous evaporation that is constantly going on in bodies; and that the air has an effect as a solvent in this case, appears

1. From its always containing a proportion of water.

2. From more water being evaporated in a denſe than a rare atmoſphere, and,

3. From ice diminiſhing in weight even in a temperature under 32.

CLIX.

The ſolvent power, however, of air is much increaſed by a high temperature; and in this high temperature it takes place, even in a degree greater than the bare ratio of augmented temperature can account for.

CLX.

As the gravity or preſſure of the atmoſphere is conſtantly varying, to mark this variation an inſtrument called a barometer has been invented. This inſtrument conſiſts of a tube containing a column of mercury 28 inches in height, being aſcertained as the exact counterpoiſe of a column of air, of the height of the atmoſphere. This tube being open below, and having a vacuum above, the mercury riſes and falls in it according to the varying ſurface of the ſurrounding or circumambient fluid.

CLXI.

With the ſame view, to determine the varying quantity of water the atmoſphere contains, another inſtrument, the hygrometer, has been employed. This inſtrument is formed of ſubſtances which ſhrink eaſily by dryneſs, and in the ſame degree ſwell by the application of moiſture.

CLXII.

IV. *Alkaline Air (Ammoniacal Gas).*

This air poſſeſſes a ſtrong pungent ſmell, and is even ca-

pable of inflaming the ſkin of animals. Its lightneſs is next to that of inflammable air, and in ſpecific gravity it falls ſhort of atmoſpheric air, in the proportion of 600 to 1000, and it is incapable of ſupporting animal life, and alſo combuſtion, though the flame of a candle enlarges before it is extinguiſhed. By it is proved to be a compound of this azote and hydrogen, 1000 parts of it containing 807 of azote, and 193 of hydrogen. This air has a ſtrong attraction for water, and is rapidly abſorbed it. When diſſolved with water it produces heat; and w diſſolved with ice it produces cold.

CLXIII.

V. *Nitrous Air (Nitrous Gas).*

This air is colourleſs, and incapable of ſupporting either animal life or combuſtion. It is compoſed of oxygen and azote, in the proportion of 56 to 44. Its ſpecific gravity to that of atmoſpheric air, is as 119 to 100. Though incapable of ſupporting combuſtion in general, ſome ſubſtances burn in it with ſplendour. It does not redden any of the vegetable colours, or ſhew any acid properties. Its moſt ſtriking and important property is the facility with which it combines with vital air. This ſhews itſelf on the immediate admiſſion of atmoſpheric air, by the appearance of red fumes, and the diminiſhed volume of the air. When oxygen is admitted pure, the diminution of volume is ſtill more rapid; 2½ parts of this gas are ſaturated by one of oxygen, and by this combination no light and little heat is extricated. From this circumſtance of its combination with oxygen in a common temperature, and its forming a compound eaſily abſorbed by water, it has been applied to the uſes of eudiome-

try. Thus a given quantity of the gas is added to the air containing oxygen. The diminution of volume produced, is meaſured by a graduated tube, and the quantity of oxygen eſtimated from the quantity of oxygen required to make a full diminution. But though this method forms the eudiometer of Prieſtley, Ingenhouz, and Fontana, it is by no means accurate in its reſults, being influenced by a variety of minute circumſtances. When mixed with hydrogen, this air burns with a green flame.

CLXIV.

VI. *Dephlogiſticated Nitrous Air* (*Gaſeous Oxyd of Azote*).

This air reſembles vital air in both ſupporting combuſtion and animal life. Phoſphorus burns in it with ſplendour and ſulphur with a vivid roſe coloured flame. But this combuſtion only takes place, when bodies are raiſed to a higher temperature than what is neceſſary in vital or atmoſpheric air. In maintaining life it acts as a powerful ſtimulant without producing any exhauſting effects. By means of the electric ſpark it is converted into nitric acid and atmoſpheric air, and its conſtituent parts are 37 of oxygen, with 63 of azote.

CLXV.

VII. *Fixed Air* (*Carbonic Acid air*).

Fixed air, or aerial acid, is incapable of ſupporting combuſtion and animal life. It poſſeſſes a penetrating odour, and ſour taſte. It reddens the vegetable colours, and its compoſition ſeems to be 28 parts of carbon, or the peculiar inflammable matter of charcoal, and 72 of oxygen with a certain portion of caloric. The proof of this ap-

pears that pure charcoal being burnt in a vessel of vital air, carbonic acid is directly formed in a quantity precisely equal to that of the two ingredients employed.

CLXVI.

This air was first discovered by Dr Black. It [illegible] is abundantly in nature, and is produced in a variety of circumstances. It is heavier than the air of the atmosphere in the proportion of $1\frac{1}{2}$ to 1 part. [illegible] in a pure state in many subterraneous places, [illegible] by the common name of choke damp. It is generated during the decomposition of animal and vegetable [illegible] fermentation. It composes [illegible] third of [illegible] of calcareous substances. It is [illegible] by the [illegible] tion of animals, [illegible] likewise by the [illegible]. Water absorbs an equal bulk of [illegible] temperature, and under the common [illegible] of the atmosphere, and it acquires [illegible]. It forms therefore a constituent [illegible] in many mineral waters, which acquire from it [illegible] and sparkling quality.

CLXVII.

VIII. *Hepatic* [illegible].

This air is distinguished [illegible] by its [illegible] smell or sulphureous odour. It [illegible] animal life, and reddens the vegetable colours. It extinguishes flame, but in contact with vital air, it burns with a light blue flame, and at the same time deposites a residue of sulphur. It prevails abundantly in the sulphureous mineral waters which are saturated with it. It consists of a compound of sulphur and inflammable air in the proportion of [illegible] parts

of the ſulphur, every ſpecies of Hepatic indicate a ſlight acidity.

CLXVIII.

Hydrocarbonate (*Carbonated Hydrogen Gas.*)

May be conſidered as a modification of fixed air. It is inflammable; it is heavier than atmoſpheric air as 11 to 23. It is more immediately fatal to animal life than the greater number of gaſes, and it has the peculiar property of communicating to the blood and muſcles a florid red hue. The compoſition of this air is 4 parts of carbon, 3 of hydrogen, and 9 of water.

CLXIX.

Two oth . modifications of the ſame gas are alſo duced.

The one contains a larger proportion of carbon, the other a larger proportion of oxygen.

CLXX.

9. *Vitriolic Air*, (*Sulphuric Acid Gas.*)

This air has a ſtrong ſuffocating odour and acid taſte, proves ſpeedily fatal to animal life. It is not inflammable, and extinguiſhes combuſtion. It is abſorbed by water, the ſolution retaining the pungent ſmell of the air. It renders the vegetable colours white. By water it is imbibed in the quantity of 90 times its bulk, and it is not expelled by freezing, like other kinds of air.

This air is a compound of ſulphur and oxygen, the latter being in a leſs proportion than in the ſulphuric acid, with a certain quantity of caloric.

CLXXI.

10. *Marine Acid Air*, (*Muriatic Acid Gas.*)

This air has a penetrating ſmell: it is ſharp without being cauſtic: it extinguiſhes flame, and proves fatal to life. Mixed with atmoſpheric air, it even excites a ſenſe of ſuffocation. It is heavier than common air, and as it extinguiſhes flame, it enlarges it by a greeniſh or blueiſh circumambient circle. Its ſpecific gravity to that of atmoſpheric air is as 5 to 3.

CLXXII.

11. *Phoſphoric Air*, (*Phoſphoric Acid Gas.*)

Phoſphoric air has a fetid putrid ſmell, it enflames on coming into contact with atmoſpheric air. It detonates when mixed ſuddenly with oxygen. It is ſpeedily deſtructive of animal life. It ſlightly reddens tincture of Litmus. It conſiſts of a ſolution of phoſphorus in inflammable air.

CLXXIII.

12. *Air of Sparry Fluor*, (*Fluoric Acid Gas.*)

This air has a pungent penetrating odour. It is incapable of ſupporting combuſtion. It is heavier than atmoſpheric air. Its conſtituent principles are not aſcertained.

CLXXIV.

Having thus examined, in a general way, the natural and factitious airs, and detected their leading properties, we are next to conſider their application to the purpoſes of medicine. Till the diſcoveries of modern chemiſtry, the uſe of airs in medicine was confined ſolely to the atmoſpheric, and its relative degrees of ſalubrity engaged alone the attention of phyſicians. The firſt of the factitious

airs that came to be introduced was the Fixed air, or carbonic acid gas, in consumption and several other complaints. Since that time the labours of Dr. Bedoes have opened a new field of speculation, and the general application of this form of bodies in the cure of diseases has been attempted, if not always with success, at least with a considerable palliation of many urgent symptoms.

Of the different airs, we find three alone capable of maintaining life, viz. vital air, atmospheric air, and dephlogisticated nitrous air.

CLXXV.

Vital air, when inspired pure, or nearly so, increases the activity of every part of the system, and to that degree as often to occasion violent and mortal inflammations. By giving an increased redness of color to the blood, it brightens that of the solid parts: even the liver, the organ the least disposed to assume this appearance, seems to partake in the general change induced by it. That it increases the powers of life, is evident by its rendering animals less capable of being drowned or destroyed by cold: that it is exhausted by muscular exertion, is evinced by animals that have been much in motion, sooner exhausting a certain quantity of it. When blown into the cellular membrane of animals it is found to excite an uncommon vivacity. To these effects may be added its strong power of irritation on the surface when any part of it is denuded. Thus a sore immersed in vital air, has its inflammation and smarting soreness powerfully encreased. At the same time this very effect may prove useful in ulcerations, and the application of oxygen or bodies containing it may be a powerful means of cure.

CLXXVI.

In consumption the use of vital air has been found highly pernicious, and this in a great number of cases tried by different practioners. The cough is encreased by it, the fever becomes more violent, and all the symptoms are aggravated. The same is to be observed in astuma, where the stricture and uneasiness of the chest are rendered more severe, in consequence of its application. But in diseases where the patient has been affected with languor and debility, this air has been found highly serviceable. It has been employed in cholorosis with sudden relief. In coldness of the extremities of the old and infirm, it has been remarkably efficacious. It excites a flow of animal spirits, without that exhaustion consequent on the use of other stimulants. In malignant fever also its exhibition has been attended with the most marked success.

CLXXVII.

From this circumstance of the hurtful effects in phthisis of oxygen in a pure state it naturally occurred, that its combination with azote in a varied proportion from what it is in the atmosphere might correct this hurtful tendency, and render it on the contrary, from the facility of its application to the seat of the disease, a principal means of cure.——Various tables of this kind have been formed by Dr. Bedoes both of a higher and lower standard of atmospheric air, the latter of which has been accordingly found particularly useful in consumption, both in retarding the progress of the symptoms and in altering the fetor that attends the discharge. Thus he has varied the proportion of oxygen from 28 parts in the 100 in common standard to 88, in his higher scale, and diminished the azote to only 12,

while in the lower scale he has encreased the azote to the length of 95, and the oxygen to no more than 5.

CLXXVIII.

Next to vital air the dephlogisticated nitrous air falls to be noticed, in its effects upon the animal system. These effects are of the most singular kind, and eminently distinguish it from every other chemical agent. Formerly it had been supposed, with most of the other gases, noxious to animal life; but this arose entirely from the impurity of the gas employed. When pure it is breathed with safety, and attended with the most animating powers, that pervade every part of the system. It operates as a most active stimulant, every fibre is excited to action by it, a sense of thrilling is produced over the whole body, the most pleasurable sensations are experienced, the faculties of the mind are roused. A state of high exhilaration prevails. This is succeeded by no langour or debility, but a degree of vigour rather ensues, and a desire to exertion which gradually, after a certain time, subsides. Such are its effects either when breathed pure, or mixed with atmospheric air. In the former case, however, it can only be continued for four or five minutes at a time, otherwise from its high stimulant powers, insensibility would be induced, for an animal confined in it dies even sooner than in vital air, from the high excitement it occasions. It promises, however, to be a remedy of high powers in the treatment of of many diseases of debility.

CLXXIX.

The use of the unrespirable airs has also been attempted, and the effect of some of these shall next be noticed.

Hydrogen air may be cautiouſly employed, mixed with three or four parts of atmoſpheric air: of this mixture inſpired for a few minutes, the reſult is in caſes where diminiſhed action is required, as in inflammation of the lungs, with pain, full pulſe, and fluſhed face, that relief is in a few minutes experienced. The ſame has been found equally beneficial in croup, and in the laſt ſtage of the diſeaſe, as a powerful palliative of phthiſis. In general it produces at firſt a ſlight degree of nauſea. It acts as a powerful anodyne in inducing ſleep.

CLXXX.

Fixed air ſhould not be uſed in greater proportions to atmoſpheric than from $\frac{1}{5}$ to $\frac{1}{6}$. In this proportion it relieves phthiſis, and is particularly uſeful in the dyſpnoa that attends it. It has even been propoſed to uſe it in the day, and the former air, as an anodyne, at night. Of the modifications of fixed air, the uſe of the hydro-carbonate requires much precaution. Of all the gaſes it produces the moſt depreſſing effect, even in a proportion of 12 parts of atmoſpheric air, to 1 of it. The extremities have been chilled on the very firſt inſpiration of it, and this weakening effect has continued for long after.

CLXXXI.

To facilitate the application of this ſubject to medicine, it is proper to examine next the methods of employing theſe gaſes, or producing them with moſt eaſe and convenience, and this has been particularly pointed out by Mr. Watts, and is detailed at large in Dr. Bedoes's eſſays.

CLXXXII.

Class II. *Waters.*

The next clafs that follows the confideration of airs or elaftic bodies is the waters formerly defined. They may be divided into fimple water, and its various impregnations.

CLXXXIII.

Simple Water.

Water, when pure, is taftelefs, inodorous, colourlefs, and tranfparent. It is 850 times heavier than air, and though long confidered as an elementary body, chemiftry has been able to decompofe it as well as others.

CLXXXIV.

From this decompofition water is found to be a combination of oxygen and hydrogen, and the direct proof of it is brought by fubjecting 15 parts of hydrogen to combuftion in a clofe veffel with 85 parts of oxygen, when water is the product formed, and that in weight equal to the gafes employed. Many other proceffes produce the fame effect, where their principles are combined, and again feparated.

CLXXXV.

This fluid enters into the compofition of moft bodies in the animal, vegetable, and mineral kingdoms, either in a ftate of combination or fimple mixture. Hence the antient philofophers fuppofed that all things were derived from water, and they muft have had a very extenfive view of the operations of nature, for the dew, the clouds, the rain, the fnow, and other meteors, all confift of water, and the numerous tribes of animals and vegetables all

arise out of it. When water is taken away nothing remains but the solid parts of the globe. But even these shew that the water has been, at least, the agent employed to arrange and dispose them into their present condition into the regular disposition of the materials of which we find them formed, into extensive beds, parallel to one another. This shews that the arrangement is the consequence of the disposition of the materials from water, and we are still more truly fixed in this opinion when we reflect upon the numerous relicts of the productions of water, and of the sea which are found in these strata Hence it has even been attempted to be proved that water furnished the materials itself.

CLXXVI.

Water, we find, exists in three different states: in that of a solid, as in ice; in that of a liquid, its most common form; and in that of vapour or gas.

Ice.

The first is its natural state. It takes place at the temperature of 32 of F. and the phenomena observed in its passing into this state are; 1. a sensible production of heat at the moment the water passes into the solid form, which shews the escape of caloric to effect this; 2. its being favoured by exposure to the open air; and, 3dly, its being facilitated also by the agitation of its parts allowing the more rapid escape of its caloric.

CLXXVII.

Ice then is water in the crystallized form, and in quence of this form it acquires elasticity. Its taste assumes more of a saline caustic nature, and its gravity

leſſened. As it paſſes into the liquid ſtate, which is at ſome degrees above 32, it produces cold by the abſorption of a portion of heat, and hence the practice of the fuſion of ice, to procure additional cold for different purpoſes.

CLXXXVIII.

Fluidity, the ſecond ſtate, is the more common form in which water is preſented to us, and its properties in this ſtate we are chiefly to conſider. This ſtate depends on encreaſe of its temperature, by which a conſiderable quantity of heat or caloric becomes fixed in it, and it is prevented from paſſing into a ſtate of vapour by the preſſure of the atmoſphere.

CLXXXIX.

In this ſtate water is very ſeldom pure, for from its ſtrong ſolvent powers, it has been termed the grand ſolvent of nature. From the degree of admixture it receives, it becomes more or leſs wholeſome to the human body; and we ſhall examine it therefore, firſt, in its more ſimple, and 2dly, in its impregnated ſtate.

CXC.

Pure water then, as commonly uſed for domeſtic purpoſes, we conſider as nearly the ſame, unleſs ſubjected to the proceſs of diſtillation, when it is procured in the leaſt tainted form. Thus ſpring, ſnow, or rain water, collected at a diſtance from houſes and diſtilled to two-thirds, will be ſufficiently pure for any purpoſes.

Rain water is very like diſtilled water, if collected at a diſtance from houſes; but even at a moderate diſtance from houſes the ſmoke which ſettles upon the tops of hills is waſhed off, and renders the water impure, ſo as to poſ-

sess even a strong taste and smell. On other occasions the stamina and dust of flowers and plants thrown up into the air, descend with the rain, and taint it. Springs which are originally produced from rain water falling in the higher grounds, and penetrating through the soil, find their way through strata of sand, till they are stopt in their descent by more solid strata, when they are moved horizontally till they come out in low grounds; and, according to the different soils they pass through, they turn out more or less impure. The waters of rivers and lakes are necessarily infected with animal and vegetable matter, especially rivers running from mossy grounds, which are generally tinged with a deep brown colour, by an infection of matter from the putrifying moss or turf.

CXCI.

The most impure water is that of morasses and stagnating pools. These abound with large quantitics of animal and vegetable matter, particularly living insects in great abundance, and those have given occasion to a mistake, with regard to such waters, that it was suddenly converted into blood. There is an aquatic insect, which is sometimes produced in great numbers, so as to give a thickish consistence to the upper surface, and it has a red colour. From this cause has such a vulgar ideas been at times entertained.

CXCII.

The most common division of water for domestic uses, is into hard and soft. A water is said to be hard when it [illegible] not dissolve soap, but renders the surface of the soap greasy, and it is a long time before any of the soap

can be diffolved, which rifes in the form of a greafy fcum. Such waters are unfit for boiling vegetables, and it depends on a portion of acid fet loofe, which acts upon the alkali of the foap. Soft water, again, is the oppofite, or poffeffes admixture in fuch a flight degree as not to fhow any of thefe effects.

CXCIII.

From a comparifon of different waters, which are reckoned good, it would appear that water is not reckoned hard if it contains lefs than 10 grains in the pound weight of thefe materials. If it contains that quantity, or a little more, it poffeffes the qualities of hard water.

CXCIV.

The 2d divifion of water, containing its various impregnations, is a fubject of much importance; few bodies, as already obferved, are exempt from its action. It abforbs fmall quantities of the fimple gafes, and is alfo diffolved by them, nor can they be entirely freed from it. Hence its ftrong attraction for oxygen on every occafion. It abforbs alfo atmofpheric air, from which it becomes fparkling, and is rendered alfo lighter on the ftomach. But its impregnations with the mineral kingdom, are moftly employed for the purpofes of medicine and mineral waters, the term diftinguifhing fuch impregnations, may be divided into the hot and cold fprings. Between thefe there is no very precife limit. We find fprings of all the different degrees of heat from 48 to boiling water, but thofe not fenfibly exceeding 58 are reckoned cold fprings, and all the reft hot ones.

CXCV.

The admixture of ſubſtances which form mineral waters, is very various; but the arrangement is to be made from the predominence of one particular ingredient. Thus they have been divided into the acidulous, ſaline, ſulphureous, and ferruginous waters.

CXCVI.

Acidulous Waters.

The firſt claſs are thoſe in which the carbonic acid gas, or fixed air, is moſt prevalent. They are known by their briſkneſs and pungent acidulous taſte. They boil with facility, and afford bubbles by ſimple agitation. They redden alſo the tincture of turſole, and precipitate lime water, and alkaline ſulphurs. This quality, however, they diſcover becomes very ſoon loſt, the carbonic gas flies off, and they are preſerved in perfection with great difficulty.

CXCVII.

All ſuch waters, beſides this predominance of carbonic gas, poſſeſs alſo always more or leſs of an alkali, and calcareous earth; and from theſe ingredients they are found to acquire various degrees of temperature; hence they have been divided into two orders, of the cold acidulous, and alkaline waters, and of the hot or thermal, acidulous, and alkaline waters.

CXCVIII.

Saline Waters.

The 2d claſs are thoſe waters in which a neutral ſalt is moſt conſpicuous, and this they ſhow by acting ſtrongly on the human body as a purge. They are to be regarded

therefore as salts suspended by a natural solution. The salts most commonly found in such waters, are the Epsom salt, the marine salt, and calcareous and magnesian muriates; but the proportion and number of these vary so much that they admit no distinct arrangement.

CXCIX.

Sulphureous Waters.

The 3d class comprehends the sulphureous waters, or those which discover sulphur to the smell, and also have the property of discolouring silver. This substance is found to exist in them in two states, either in the form of sulphurated hydrogen gas, or in a solution of alkaline or calcareous sulphur, and they may be divided into two orders corresponding to these different states.

CC

Ferruginous Waters.

This class is the most numerous of all the mineral waters, and in it the ferruginous principle, or iron, predominates. From the manner, however, in which this solution takes place, ferruginous waters are divided into three orders; 1st, The martial acidulous, in which the mineral is dissolved by the carbonic acid; 2d, The simple martial, in which no excess of acidity prevails to detect this solvent; and, 3d, The sulphureous martial, in which is contained the sulphate of iron. The impregnations of this class are not confined to the mere solution of iron, but they possess also an admixture of calcareous and saline matter, though their principal medicinal property depends on the iron.

CCI.

To ascertain, with precision, these principles in mineral waters, various tests are employed, and the manner of applying for this purpose the most common of them, we shall prosecute in the order of the arrangement.

1. Acidulous waters are detected by an infusion of litmus, which turns the water red, and afterwards, when boiled, returns it to blue, or by paper stained in litmus, which is reddened when wet, but becomes blue when dry.

2. Saline waters are discovered by turning syrup of violet green, which thus shews the presence of an alkali, and calcareous earth is detected by a solution of lead in nitrous acid, which the water immediately precipitates, so as to produce a muddiness.

3. Sulphurous waters are known by turning infusion of litmus red, and by blackening polished metals.

4. Ferruginous waters are distinguished by blacking infusion of galls, and the dissolving acid is ascertained by observing whether it produces its effect before or after

CCII.

Such then is the composition of water, and its principal impregnations in its second or fluid form; but it is presented also in a 3d state, or that of vapour, when it acquires new properties distinct from what it displays in its two other forms. This form or vapour was already considered (XXXVIII) as an effect of heat, and it is evident that a true distillation of water is every where carried on at the surface of the globe. Thus it is raised by the heat of the

ſun; in that form it remains ſuſpended a certain time in the atmoſphere, and afterwards falls down in its liquid ſtate under the name of dew. By this means the atmoſphere is freed of theſe combinations, which by their corruption or developement might render it infectious, and hence alſo the unwholeſomeneſs which is found to attend the evening dew. To this cauſe is referred alſo the formation of clouds in the higher regions, when in conſequence of cooling or compreſſion, the caloric ſeparates from the finely divided particles of water which formed the baſis of vapour, and which now approximate to return to the liquid ſtate and deſcend in rain.

CCIII.

Waters are a claſs of bodies of the firſt importance in medicine, and they are equally important to the preſervation of health, as the obviating diſeaſe.

CCIV.

Water enters largely as a conſtituent part into all animal and vegetable bodies. It forms the ſolvent or baſis of all the fluids of every living and organized texture. Its proportion in the animal fluids is rated at nearly [illegible], or as 90 to 128, though this quantity will no doubt vary with the circumſtances of the health of the animal. It continues alſo at all times the leaſt animalized part, while circulating in the ſyſtem. Hence the loſs of it is eaſieſt ſupported, and alſo moſt readily repaired. Two of the excretions ſeem particularly intended for its removal from the ſyſtem. Theſe are the perſpiration and urine. The former, in its natural ſtate, contains nothing but water, with a ſmall pro-

portion of ſalt, either to the taſte or ſmell, and only under an encreaſed action, does it acquire ſeemingly an animalized ſtate, as diſplayed by its peculiar odour. In the excretion of urine, the proportion of ſimple water is alſo great, and rated at about $\frac{16}{20}$ to $\frac{48}{50}$, though it is more liable to variation, from different circumſtances, than the former. Thus water is the principal ſolvent for all the alimentary matters the body receives, is the baſis of all the ſecretions and excretions it performs, and enters largely as a conſtituent part into its general fabric.

CCV.

The firſt effect of water we find to be facilitating the proceſs of digeſtion, by holding in ſolution, and conveying in a form fit to be acted upon, the materials of ſolid animal food. Along with this it forms alſo itſelf a neceſſary aliment, and retains the due proportion of ſolid and fluid parts, neceſſary to the preſervation and well-being of the ſyſtem. Dilution, therefore, though not neceſſary in a great degree in ſtomachs poſſeſſing much activity or tonic power, is highly neceſſary where the powers are ſomewhat impaired, as preventing the chemical action of the contents of the ſtomach on the organ, and as haſtening their paſſage into the inteſtines. That a certain proportion of it however is required for the due performance of the ſeveral ſecretions and excretions cannot be doubted, and an exceſs will always be leſs dangerous than the reverse, eſpecially when we conſider that the animal fluids are gradually becoming unfit to remain in the body; and in order to their regular removal they require a timely ſubſtitution or ſupply. To examine the ſubject however properly, the na-

ture of the food and ſtate of the ſtomach deſerve to be attended to.

CCVI.

In all caſes of thin watery food, it is clear little dilution is required, and where the food is not of a very ſtimulant kind. Hence vegetable food demands leſs of this beverage or ſolvent than animal. Animal food is alſo liable ſooner to theſe ſpontaneous changes which render it unfit to be retained, and its exceſs of nouriſhment requires alſo its quicker exit.

CCVII.

The ſtate of the ſtomach is an important conſideration in the choice of aliment. When weakneſs prevails in this organ from any cauſe, dilution is of great conſequence, and this dilution ſhould even conſiſt in a previous preparation of the food in the liquid form, ſo that leſs action may be required in aſſimilating it.

CCVIII.

As a remedy in diſeaſe, the uſe of water is equally important as in health. In acute diſeaſes an exceſs of ſolution is always of the firſt importance. It is peculiarly marked as a characteriſtic ſymptom, by the thirſt that attends, and it is generally deſired of the loweſt temperature that can be procured. In dwelling on this ſubject, therefore, the quantity and temperature are the chief points to be deſcanted on.

CCIX.

In all caſes of acute diſeaſe, both ſolids and fluids are equally affected. The encreaſed force of the ſolids requires a ſupply to keep their action from being hurtful, and

this supply is best afforded by water, for it also bestows the necessary fund to prevent the morbid state the fluids are under this action liable to assume. By a proper supply of water the febrile action will be lessened, the process of perspiration restored, and the encreased heat connected with its obstruction diminished. Nor is there any danger of that temporary plethora, which has alarmed some writers, unless the water is suddenly thrown in and where of course it acts on the stomach alone. Where large dilution is to take place, it should always be done in divided doses, and its activity should be even encreased, or the passage of the fluid accelerated, by its junction with such mild remedies, as will give it a tendency to pass off by the excretions.

CCX.

The temperature of the diluent is equally important, as its quantity, and the degree of cold to which water, either as a drink or a bath, may be carried, is in direct proportion to the degree of animal temperature above the natural standard, and this again is proportioned to the vigour of the body, and to the strength of the disease.

Where the power of the stomach is strong, the degree of cold may be greater, which will encrease the force of re-action, relax the extreme vessels, and occasion a freedom of perspiration to ensue, while in order to take advantage of this circumstance, the cold stage of fever should be avoided, and this re-action attempted, during the hot fit. For in the cold stage the dilution should be hot, and in the sweating one, tepid, or of a mild temperature.

CCXI.

In chronic diseases, the use of water is of equal benefit as in the acute, and for this purpose it is necessary it

should be chosen as soft as possible, and as free from adventitious mixtures. The effects produced by the use of hard water have not been fully ascertained; they have been supposed indeed as the cause of calculous complaints, though this is by no means sufficiently established. In considering water as a drink, we are to judge of it entirely by the degree of its solvent powers; and on this idea, soft water is certainly to be preferred, as all animal, vegetable, and saline matter is easier dissolved by it out of the body than by the other. Indeed in many instances hard water is known to produce dyspeptic symptoms in them that possess an irritable state of the stomach, particularly women and children.

CCXII.

On these accounts the softer water is to be used as a medicine, and it will be found particularly useful in affections of the stomach and bowels: these complaints originate for the most part in irregularities in diet, particularly from excess. Though abstinence is, in many cases, the proper remedy, yet few patients can be found capable of submitting for any length of time to strong privations of accustomed indulgence. In place of it, therefore, nothing can be substituted so useful as a proper supply of diluents, as they correct the cause from which the disease proceeds, as far as it can be done. The constant and habitual addition of a large quantity of water, in divided doses, is therefore the best prescription that can be offered. It will remove the effect of excess of aliment, as well as its too great stimulus, and wash off any morbid irritation it leaves behind. Other remedies will be also found always rendered more successful, by being joined with it.

CCXIII.

Nor is its temperature in this cafe to be neglected. In all chronic difeafes it fhould poffefs a temperature nearly equal to animal heat. Delicate and irritable ftomachs require this, in order that the procefs of digeftion may not be interrupted, and the weak action of their ftomachs rather impaired: a pain of ftomach, the effect of crudities, is often entirely removed by warm water.

CCXIV.

The good effects of fimple water drinking have been long obferved on the duration of life, and water-drinkers have been proverbially regarded as long livers. The permanence of their health, the regularity of their appetites, and the force of their intellectual powers, have all been circumftances taken notice of and defcanted on.

CCXV.

But the ufe of water, externally applied to the human frame, is equally beneficial, under certain circumftances, as its internal exhibition, and this includes the fubject of cold and warm bathing.

CCXVI.

By cold bathing is underftood, the application of water to the furface or fkin, in a temperature much below that of the animal heat, and in this degree it is an agent capable of producing very powerful effects on the fyftem, and from the temperature alone thefe effects of it arife.

CCXVII.

The falutary effects of cold bathing confift entirely in the power of re-action the fyftem poffeffes, or in the degree

of returning warmth which fucceeds the firft fhock or fenfation of cold. Beyond this period it fhould never be continued, whether ufed in health, or as a remedy againft difeafe. This requires to be particularly kept in view, as from the power of water in conducting heat, a continuance in this cold medium for any time rapidly exhaufts the powers of life.

CCXVIII.

The exertion of fwimming ftrongly exemplifies this fact, which in this climate can be employed only for a very fhort time, while in the warmer climates, where an encreafed temperature of this medium prevails, no fuch debilitating effect is experienced from it.

CCXIX.

Peculiar habit or conftitution efpecially of the furface has at times a material influence on the application of this power. Thus the effect from the degree of temperature and the ftate of conftitution will be counteracted by it, and this is ftrongly difplayed in the attendants of cold and fea baths, who remain for hours under its impreffion without feeling any hurtful confequences from the diminifhed temperature.

CCXX.

Sympathy between the external and internal furface, is alfo another circumftance that regulates the effect of the cold bath. In the delicate and irritable, this fympathy produces the moft uneafy fenfations when the water reaches the level of the ftomach; and in order that it may be endured, every precaution muft be taken to render the firft impreffion in fuch cafes as flight as poffible, till a full immerfion has taken place.

CCXXI.

The changes conſpicuous in the pulſe deſerve alſo to be noticed. An irregularity and quickneſs frequently enſue, previous to the immerſion; when the latter has taken place, the pulſe becomes ſlow, regular, and in general ſmall, and this continues, and even encreaſes ſo long as the immerſion is perſevered in.

CCXXII.

The morbid affections to which this remedy is applicable, are numerous. Late experience has proved its ſucceſs in the caſe of fever; and as an exceſs of heat and diminiſhed perſpiration are the leading ſymptoms of this diſeaſe, its application, under judicious regulations, cannot fail to be of the moſt ſovereign efficacy in counteracting theſe ſymptoms.

CCXXIII.

The chief regulations to be attended to, are

1. That the heat be ſteadily above the natural ſtandard.

2. That it be applied during the hot ſtage, and when no chillneſs prevails, and

3. That there be no tendency to perſpiration, as ſhewing a relaxed, weakened ſtate of ſurface.

CCXXIV.

The ſucceſs of this means of cure, is diſplayed by a copious and general diſcharge by the ſkin, attended with a reduction of the febrile heat, and of the ſtrong marks of the re-action of the ſyſtem.

CCXXV.

In chronic diſeaſes the uſe of this remedy requires even more caution than in the acute, and here it is its tonic power alone that is called for. The chronic diſeaſes in which it ſucceeds are theſe, of ſimple weakneſs, languor or nervous relaxation, where no permanent obſtruction of any part or viſceral diſeaſe is preſent. In theſe, if the degree of temperature is proportioned to the power of re-action the conſtitution poſſeſſes, the beſt effects will follow this remedy.

CCXXVI.

The tepid bath, the 2d external form of this application, is not ſo common in this country as the cold one. By it is underſtood every degree of temperature above 92, which the ſkin can bear. It is a ſafer remedy than the cold bath, and is particularly adapted to weak and irritable conſtitutions, whom the ſhock produced by cold immerſion would everpower, and who alſo have not the vigor of habit neceſſary to re-action.

CCXXVII.

The diſeaſes to which this form is beneficial, are equally numerous as the other. To complaints of the ſtomach and bowels it is well adapted, and colic and inteſtinal obſtructions are powerfully relieved by it. Nor has it leſs influence in affections of the ſkin. Where the perſpiration is checked, or any organic derangement produced, in conſequence of its relaxing influence, if not curing, it prepares the way for the uſe of remedies with ſucceſs. In the diſeaſes of children it form a uſeful and ſafe application, as the ſympathy between the ſkin, and ali-

mentary canal prevails in them in a high degree, and diſeaſes in them are generally lodged in this laſt ſituation. In all diſeaſes attended with a loſs of nervous energy, it forms a remedy of the firſt importance. Hence its utility in palſy and all the modifications of this malady.

CCXXVIII.

These form a few hints on the general application of water to the human body: in health, as a ſolvent and conſtituent part of the ſyſtem; in diſeaſe, as a remedy powerful in removing irritation and obſtruction eſpecially where confined to the firſt paſſages, nor is its external application, as we have ſeen, leſs beneficial. Laying aſide then its ſimple ſtate, we are to examine its various impregnations, and the ſuperior efficacy it acquires from this ſource: in doing which, it is proper to conſider the principal mineral waters in uſe, according to the arrangement formerly made.

CCXXIX.

Malvern Water.

One of the ſimpleſt of the acidulous waters is the Malvern in Worceſterſhire. It is particularly uſed as an external application in ſcrofulous affections, and cutaneous diſeaſes. It is alſo uſeful internally in caſes of ulceration, and hectic fever.

The effects of this water at firſt are ſome degree of drowſineſs, vertigo, and pain of heat, which ſoon go off, and may be haſtened by a ſlight purge.

The operation of this water on the bowels is uncertain. It however produces a flow of urine, and an encreaſe of appetite.

CCXXX.

Bristol Water.

A more powerful acidulous water is the Bristol hot well. The sensible effects produced by it, are at first a gentle glow in the stomach succeeded by a slight degree of head-ach and giddiness, which soon go off. By its continued use, the flow of urine is encreased, and at the same time the skin is kept more perspirable, and the appetite and general health are improved. The effects of this water on the bowels are by no means constant, but in general a tendency to costiveness arises from their use. In taking them the quantity should be limited and never carried so far as to produce oppression or weight at stomach.

This mineral has been celebrated in a variety of disorders, and much of its success seems to depend on its encreased temperature. In pulmonary consumption it is chiefly useful in aleviating the symptoms of hectic, and in order to produce its effects it requires a considerable length of time.

CCXXXI.

Matlock Water

Is less powerful then the Bristol and chiefly used internally from its mild temperature. It has nothing particular besides to recommend it.

CCXXXII.

Buxton Water.

Buxton water is employed largely both for external and internal use. The analysis of it shews the presence of carbonic acid, but more strongly of azotic gas. As an internal medicine it possesses great activity and of course success

in the cure of many diseases. In deranged symptoms of stomach and alimentary canal it has been found of great benefit, particularly where these symptoms are the effect of indulgence and high intemperance. Thus a judicious use of them will often relieve the uneasy symptoms of heartburn, flatulency, and sickness; and from a due perseverance in them, an encrease of appetite and regularity of the secretions will ensue. On the bowels the waters appear to produce various effects. Not unfrequently a spontaneous diarrhoea comes on from their use for some days, which is attended with beneficial consequences, but costiveness is a more common effect of their operation, especially in sluggish habits. For complaints of the kidneys and bladder these waters have been supposed of sovereign efficacy, and more especially when such complaints are attended with much pain and irritation. They have been recommended in gout; but here they are of more ambiguous operation, and the chief thing to be attended to in this disease is temperance in the use of them. This water has been particularly prohibited in cases of active inflammation, and where a strong determination prevails to the lungs. This arises from the supposed heating qualities of the water, and therefore it is more suited to chronic than acute diseases, and more especially in which there prevails little vascular action.

The external use of the Buxton waters as a bath differs in nothing from the common tepid bath. Its temperature is at 82, and it gives therefore little or no shock at immersion, while its application is succeeded by a highly glowing and pleasurable sensation over the

whole body rendering it warm and unctuous. It is well suited as a bath to the delicate and irritable, by whom much cold cannot be endured, and where the degree afforded by the Buxton water is yet sufficient to produce that re-action which forms a salutary effort of the constitution. But its use has been more particularly confined to affections of limbs where a loss of action or sensation has taken place. Thus chronic rheumatism is much benefited by it, and it may afterwards be succeeded by the common bath, or one of a lower temperature.

CCXXIII.

Bath Waters.

The Bath waters have been more celebrated than most others. When first drawn they are quite clear and colourless, and remain quiet, without any bubbles or other appearance of effervescence. By standing in the open air, the water acquires in some hours a turbidness, and a pale yellow ochry precipitate descends from it. The quantity is small, [illegible] and the turbidness continues afterwards, without any further precipitation. No perceptible colour takes place from this water, except in large quantities, when a pungency touches the nose, but neither fetid nor sulphureous. When hot from the pump, the water fills the mouth with the impression of a chalybeate, but on cooling this is lost, and gives place to the sense of a saline impregnation, resembling what is termed hard water. The Bath water is of a hot temperature, and when first drawn is from 112 to 116. Its chief ingredients to which it owes its activity are the carbonic acid, and azotic gas. On account of the high repute of these waters, they have been much resorted to, and they have

therefore been more examined and commented on than most others. This water, when drank fresh from the spring, has in most persons the effect of quickening the pulse, increasing heat, and exciting the secretions. These symptoms ensue soon after its use, and with certain habits leave for a considerable time an evident proof of its continuing nature, and of a peculiar stimulus excited in the nervous system. It possesses also a strong tendency to pass by urine, and by this operation of it, it is supposed to have a salutary tendency. On the bowels its effects are uncertain; but in general a costive habit is the consequence of its use as of most other remedies whose action is determined to the kidneys or skin. When proving beneficial, its first effects are to excite there a pleasing glow, soon succeeded by an increase of appetite, exhilarated spirits, and copious urinary discharges. Where the reverse of this ensues, and fever, head ach, and sickness arise from its use, the continuing it is not advisable. But the external application is often of more service than the internal exhibition, and where it possesses a preference over common water of the same temperature, this may be ascribed to the greater equality of temperature which the natural bath possesses over the artificial, and to the constant aqueous vapour in which the patients are kept immersed.

CCXXXIV.

The diseases for which this water is had recourse to, are numerous and important, and it is generally drank as well as externally applied. In all cases where a gentle, gradual, and permanent stimulus is required, it is highly proper, particularly where nothing is to be apprehended

from the temporary fever it creates. Hence in all active inflammations it is justly condemned. Chronic diseases form in general the field of its successful action; and of these in none is it found more beneficial than in chlorosis; and its external use in this case favours strongly its efficacy as an internal medicine That debility, the effect of long residence in a warm climate, and which produces obstruction in the biliary secretion, and an impaired state of the functions of the stomach and bowels, receives general relief from a course of the Bath water; and on the same principle jaundice is often cured by it That chronic state of weakness which succeeds constitutional diseases, and is attended with loss of motion, pain, and various nervous symptoms, finds particular benefit from this remedy. Hence it is the general resort of the gouty and rheumatic patients, when tired out with the inefficacy of other medicines; and in this last stage of disease they certainly often derive from this water considerable advantage. In all situations indeed where warm bathing is useful, or where a tepid diluent is beneficial, the Bath waters rate high in estimation; and therefore in cutaneous affections, hypochondriasis, and many other similar maladies, their character has been long established. At all times they require a proper and fair trial, nor till long persevered in can success be expected. This is indeed gradual; and they even require at times an intermission of their use, which should be resumed and occasionally discontinued, as circumstances indicate.

CCXXXV.

Saline Waters.

Epsom Water.

This water is transparent and colourless; and after some time leaves a bitter saltish taste on the tongue. It does not lose by exposure to the air; and, on examination, is found to contain about 5 drams 1 scruple of residuum to the gallon. This residuum contains about $\frac{7}{8}$ of sulphated magnesia, mixed with a few muriats of lime and magnesia, and the remainder is selenite. A half pint of water, therefore, contains less than a scruple of Epsom salt. This water is well adapted to that uneasiness of stomach which is attended with pain, tightness, and indigestion. In hypochondriac cases it is also a useful purgative; and when the menses are about to depart in the female, and health becomes irregular; the use of this water is attended with the best consequences. In the same way they are useful to the sedentary and plethoric, who have turned the meridian of life, and to those whose system is loaded with impurities, and shews a scorbutic taint, or what has been termed so.

CCXXXVI.

Of the same nature with the Epsom water are a variety of saline springs in the neighbourhood of London; but from the smallness of their saline principle they are very uncertain in their operation, and they require to be taken largely, to render them effectual as purgatives. For this reason sea water is perhaps preferable to any of them.

CCXXXVII.

Sea Water.

Sea water, at some distance from land, is in appearance

quite clear and colourleſs, void of ſmell, and ſhews no marks of any unuſual quantity of air of any kind. To the taſte it is highly ſalt, nauſeous, and bitter. It becomes ſoon ſubject to putrefaction, and this probably from the ſolution it holds of animal and vegetable matter. In regard to temperature, this water is much more uniform than any inland water, and as commonly uſed by us on the coaſt it is never lower in temperature than 40 in winter, and never riſes higher than 65 in ſummer. The proportion of ſalt it holds in ſolution varies in different places; but in general, on our coaſt, it is $\frac{1}{30}$ of its weight, and its ſpecific gravity is 1.0289. Its compoſition is muriated ſoda, in the proportion of near three parts, muriated magneſia one part, and ſulphurated lime in a ſtill ſmaller proportion.

CCXXXVIII.

One of the principal effects that ſucceeds the taking of ſalt water, is conſiderable thirſt, and what is peculiar to its operation as a purgative is, that it may be continued for a length of time without much debilitating the ſyſtem. It is uſed in all thoſe diſeaſes where ſaline waters are preſcribed; but its external application is much more extenſive than its internal exhibition.

CCXXXIX.

In being employed as a bath, the ſea is beneficial in all thoſe ſituations where cold bathing is admiſſible, and that is where no general inflammatory ſymptoms appear. In theſe ſituations it diſplays a conſiderable ſtimulus upon the ſurface, and this ſtimulus may be increaſed when neceſſary, either by mechanical means, as daſhing from a height, or by increaſing its temperature.

CCXL.

One of the diseases for which sea water is principally employed is scrofula in its various forms. But its good effects are confined to the first stage of the malady, and before hectic symptoms of any kind have appeared. Both the topical, as well as internal use, should take place in such cases; and in this way both its discutient and healing powers will be apparent. But whenever sea water is at all employed internally, it should be made to produce evacuation, and it should be persevered in for a length of time; for it is only by patience and perseverence, in many cases, that it proves succesful.

CCXLI.

Seltzer Water.

Seltzer water is a saline mineral, perfectly clear and pellucid, and of a sparkling nature. It is somewhat pungent to the taste, and is gently saline and alkaline. Its pungency becomes soon lost by keeping it, and as this decays its alkaline flavor increases. From the analysis of this water a superabundance of carbonic acid distinguishes it; hence its acidulous taste, and it soon putrifies, and becomes fetid in the open air. The effect of this water, when drank in moderate doses, is to raise the spirits and increase the appetite; and though no way determined to the bowels, it shews a strong influence as a diuretic. The reputation of the Seltzer water has been very great in a variety of diseases. It is esteemed particularly serviceable in some affections of the lungs, and in the hectic fever that attends them. It is highly useful in cutaneous diseases, and in various derangements of the alimentary canal. It has been likewise highly commended in diseases

of the urinary organs, and the relief it gives them is often most remarkable. In hypochondriasis it affords at least, temporary alleviation, and removes the uneasiness and spasmodic state of the first passages often experienced. Less precaution is necessary in the exhibition of this than of any other mineral water; and as it is also recommended for a sensible taste and an agreeable flavor, patients are readily induced to go on with it for any length of time.

CCXLII.

Ferruginous, or Chalybeate Waters.

Iron is the chief metallic body held in solution in water, and it imparts very sensible qualities to the fluid dissolving it. Of the chalybeate springs one of the first and most celebrated is,

CCXLIII.

Tunbridge Wells.

This water, when taken from the spring, is quite colourless, clear, and bright, having no perceptible smell, to the taste it is slightly chalybeate, and by no means disagreeable. On standing some time exposed to the air, it surface becomes covered with scum, and it has lost its chalybeate property, which shews the carbonic acid the cause of solution.

CCXLIV.

The use of chalybeate waters, in the cure of diseases, is a subject of the first importance. Soon after taking a moderate dose the pulse is raised in strength; the patient, if previously chilly and pale, feels a certain glow, occasioned by the increased circulation, and, by proper perseverance, the appetite is strengthened, and the spirits

improved: and this improvement takes place in various degrees, according to the conſtitution of the patient. On the firſt uſe, however, of chalybeate waters with many a number of unpleaſant ſenſations ariſe, as nauſea and ſickneſs, pains of the præcordia, heavineſs of head, and feebleneſs over the whole body. Theſe ſymptoms being merely temporary, ſeldom require much attention, as they yield ſo ſoon as any increaſed excretion takes place. The effect of all chalybeates is to blacken the fœces, which every patient ſhould know, to prevent any groundleſs alarm. Another conſtant effect of chalybeates is the production of coſtiveneſs, which ſhould be particularly prevented. Where ſuch waters agree, an increaſed diſcharge always comes on under their uſe; and this either conſiſts in a diſcharge of urine or in a very perſpirable ſtate of ſurface.

CCXLV.

The general operation of chalybeates is to increaſe the power of the ſecretory ſyſtem; and this takes place in that gradual and uniform manner which is attended with a permanence of ſtimulus that no way attends the uſe of other remedies. Debility and laxity of ſolid are the chief indications for their uſe, and when no marks of organic diſeaſe appear to counteract the ſucceſs of their operation. Thus in the various ſtates of dyſpepſia, the uſe of chalybeates is of eminent ſervice where atony forms the ſource of the malady. In the diſeaſes of the female ſex they have acquired the ſame reputation, particularly in chloroſis, and in that debility which is often the cauſe of abortion.

CCXLVI.

Such is the general effect of chalybeates as powerful tonics. They are superior to most of the medicines of this class, but in their exhibition a proper discrimination is required. It is in weakness chiefly, without local derangement, that their success is conspicuous.

CCXLVII.

Spa Water.

One of the most powerful chalybeates is the Spa water. It is a chalybeate in which the carbonic acid is in excess, and it is therefore strongly acidulous. It remains longer unaltered by the air than any of the other mineral waters. It is also fatal to aquatic animals, which marks its strong carbonic impregnation. The sensible effects of this water are more stimulant than any of these hitherto described, and from the commencement they painfully affect the head, and produce symptoms of vertigo. When taken in hot weather, and in a full draught, this amounts to actual intoxication, and sometimes continues for half an hour or upwards at a time, producing the same state as arises from the use of ardent spirits: but differing so far as not being succeeded by the same debility. The regular determinations of this water is to the kidneys and skin; sometimes they affect every secretion, and not unfrequently the bowels are powerfully affected by them. They readily quench thirst, and prove useful in ulcerations of the throat, the effect of relaxation. In increased discharges from the urinary passages they give material relief in removing pain and irritation, and thus they contribute to the restoration of a healthy state. In all sexual diseases, the effect of debility, they are highly

useful, and in the same way, in all consequences of preceding disease, wherever seated, where these consequences are the mere effect of relaxation, they produce a state of tone and vigour. On the same principle, wherever an inflammatory habit prevails, or local congestion is prevalent, their use is forbidden.

CCXLVIII.

Pyrmont Water.

This water, when taken from the spring, is quite clear and transparent. It has a sensible pungency to the smell, and produces giddiness in the water servers. Its taste is highly agreeable, being strongly acidulated, and in its briskness it resembles Champaigne wine. It retains strongly, at the same time, the chalybeate bitter impression; and so powerful is its carbonic principle, as when corked, at times to burst the bottles. It possesses, therefore, all the property of this acid unconstrained, and in its most active state. Accordingly, when fresh drank, it is sensibly pungent to the smell, and produces temporary intoxication. At all times it enlivens the spirits, and increases the appetite. The effects of this water on the bowels are uncertain. It is sometimes briskly purgative, and always produces on the fœces a dark colour; but its most common action is an increase of urine, and not unfrequently an eruption on the skin. Its powers over disease are the same with those of the Spa, and it is therefore to be used in all cases of debility, where an active tonic is required.

CCXLIX.

Cheltenham Water

Unites the saline and chalybeate principle. Its action,

therefore, is powerful upon the bowels. When fresh drawn it is not perfectly transparent. By standing it becomes turbid, and separates bubbles of air. It possesses a slight sulphureous odour, very perceptible on the approach of rain. To the taste it is brackish, bitter, and chalybeate. From this account it contains very active ingredients. It does not keep nor bear transporting to to any distance, the chalybeate part being soon lost by precipitation, and in the open air it even turns soon foetid. The sensible effects produced by this water on first taking it, are a degree of drowsiness, and sometimes head-ach, but which pass off even before its operation on the bowels. Its operation as a laxative is highly salutary, producing neither griping nor sense of weakness, so that it may be persevered in for a length of time, without producing any inconvenience to the body; and during its use the appetite will be improved, the digestive organs strengthened, and the whole constitution invigorated. In small doses it is apt to pass off by the kidneys. This water is much used in a variety of chronic diseases. In the cure of glandular obstructions it is considered particularly beneficial, especially where their seat is the liver and alimentary canal. Thus it is the chief restorative for the injuries of a hot climate, in respect to the secretions of these organs, and even considerable debility in such cases is no objection to its use. The operation of this water is occasionally assisted by a junction of the warm bath. Cutaneous eruptions, of a chronic nature, are also much relieved by this mineral, where their appearance is occasional, and at stated intervals. In cases of simple debility or relaxation this water certainly yields to the

other chalybeates; but wherever there is obstruction or fixed local congestion, its exhibition is strongly indicated.

CCL.

Scarborough Water.

Scarborough is another of the purging chalybeate waters, though not so active, in this respect, as the former. Its general effect, however, when taken moderately, is always to open the body rather than to pass off by any of the other secretions. It is employed in the same diseases as the former, and the same good consequences follow its exhibition.

CCLI.

Hartfell.

This chalybeate differs from the others in being held in solution by a fixed acid, the sulphuric. It is therefore a vitriolated chalybeate water. It is strongest after heavy rains, and it keeps for a long time unimpaired, shewing its ingredients to be of a fixed nature. For the cure of many diseases this water is a remedy of great reputation. Its first effects, when taken, are sometimes giddiness and sickness, especially in a large dose. Its operation on the bowels is irregular, a costiveness is most common from it; but sometimes there are gripes and diarrhœa. In all diseases of general weakness and debility, this will prove a useful remedy; and it has been therefore employed in complaints of the stomach and bowels, and in increased discharges of a passive nature, with decided advantage. Even in pulmonary consumptions relief has been obtained from its use. Nor is its benefit confined to internal exhibition. As an external

application it has proved highly ſalutary in old and languid ulcers, and checked the vitiated diſcharge, the effect of that debility of ſolid with which they are connected.

CCLII.

Sulphureous Waters.

Sulphureous waters are ſuch as poſſeſs a ſtrong ſulphureous ſmell, and the ſulphur with which they are impregnated is united either to hydrogen or an alkali, ſo as to render them very powerful agents on the human body. Of this claſs there are conſiderable varieties, poſſeſſing alſo various degrees of temperature, but they all agree in their general properties. Thus they poſſeſs a fetid ſmell, a peculiar ſweetiſh taſte, at firſt unpalatable, but ſoon reliſhed from habit. They cannot be tranſported to any diſtance without their ingredients being decompoſed.

CCLIII.

Harrowgate Water.

This water, when firſt taken, appears perfectly clear and tranſparent, and ſends forth a few bubbles, but not in any quantity. It poſſeſſes a ſtrongly fetid ſmell, and a bitter, nauſeous, and very ſaline taſte, which is ſoon borne without any diſguſt. In a few hours of expoſure this water loſes its tranſparency, and becomes ſomewhat pearly, and rather greeniſh to the eye. Its ſulphureous ſmell abates, and this ingredient is depoſited as a thin film in the veſſel in which it is kept. The volatile products of this water ſhew carbonic acid, ſulphurated hydrogen, and azotic gas. The ſenſible effects which this water excites, are often a head-ach and giddineſs on

being first drank, followed by a purgative operation, which is speedy and mild, without any attendant gripes; and this is the only apparent effect the exhibition of this water displays. The diseases in which this water is used are numerous, particularly those of the alimentary canal, and irregularity in the bilious secretion. Under this water the health, appetite, and spirits improve; and from its opening effects it cannot fail to be useful in the costive habit of hypochondriasis, which requires to render it soluble, a remedy of this mild operation. But the highest recommendation of this water has been in cutaneous diseases, and for this purpose it is universally employed, both as an internal medicine and an external application. In this united form it is of particular service, even in the most obstinate and complicated forms of cutaneous affection; nor is it less in states and symptoms supposed connected with worms, especially with the ascarides; and in order to prove successful here it should prove briskly purgative.

CCLIV.

Moffat Water.

Moffat water, when first drawn, appears rather milky and bluish; the smell of it agrees with that of Harrowgate; its taste is simply saline and sulphureous, without any thing bitter; it sparkles on turning it from one glass to another. The only sensible effect of this water is increasing the flow of urine, and it only purges after an excessive dose, which is more owing to the bulk of water than the mineral ingredients. The success of this water has been chiefly displayed in cutaneous eruptions, and the external application of it in an increased temperature, has

been equally trusted to, as its internal exhibition. Scrofula is also a disease for which it is alleged to prove a sovereign remedy. It is chiefly, however, in the earlier stages of this malady that it has afforded the most complete relief, and tumours have been dispersed by it without suppuration. In irritable ulcers it is used at the same time as an external application, nor are its effects confined to this disease, in bilious habits and dyspepsia it forms a frequent remedy, where a want of action prevails in the alimentary canal.

CCLV.

Aix La Chapelle Water.

This water is at first perfectly colourless and pellucid. It sends out however a strong sulphureous odour, so penetrating in close weather as to strike the nose at a considerable distance. The taste of this water is saline, bitterish, and rather alkaline, and both the taste and smell are more powerful in proportion to it heat. On standing this water acquires a milky hue, and deposits an earthy sediment. By this deposition it loses much of its smell, and when cold retains scarcely any, which may be again renewed by heating it. This water is particularly distinguished by a vast quantity of sulphur it holds in solution; and it is this principle suspended in hydrogen to which it owes its activity. The sensible effects of this water are but few. It produces in general some chearfulness and gaiety of spirits, but taken largely it affects the head, and brings on vertigo and sleepiness, and the more so if it is hot. It sometimes excites nausea from its strong smell and taste till the patient is accustomed to them; but this effect is merely temporary. In their operation these

waters prove mildly laxative, when liberally taken, though this is greatly determined by the ſtate of ſtomach of the patient. The increaſed determination to the kidneys and ſkin is a more uſual effect of their operation, particularly the latter; and this ſtate is highly favourable in the diſorders for which they are commonly uſed. During a courſe of theſe waters they impart a ſulphureous ſmell, and ſilver in the pockets of the patient is tarniſhed. The diſeaſes to which theſe waters adminiſter relief are numerous; affections of the ſtomach and biliary organs are among the principal. Diſorders of the kidnies and bladder attended with much irritation and mucous diſcharge, receive alſo benefit. They are regarded as improper in all active inflammatory ſtates, and particularly where a hectic fever, diſeaſed ſtate of the lungs, or diſpoſition to hæmorrhage prevails. Theſe waters are even more extenſively employed as a hot bath than as an internal medicine, and they are more medicated than any others in uſe. From their high temperature and ſulphureous impregnation, they are powerfully detergent, and are found of particular ſervice in ſtiffneſs and rigidity of the joints and muſcular parts, particularly in the conſequences of gout and rheumatiſm, and that weakneſs which attends palſy. In every cutaneous eruption they are of eminent benefit; and in this caſe the internal exhibition of the water ſhould be enjoined. It is alſo a powerful tonic in that relaxation which ſucceeds a long continued uſe of mercury. This water is even ſo hot in its natural temperature as to form a vapour bath. In this form it is much more liable than in any other to affect the head, and occaſion fluſhings of face, and other marks of deter-

mination to the head, which require a guarded uſe in applying it as a remedy. It is therefore only occaſionally employed, in order to act as a powerful ſudorific, and to aſſiſt the action of the other forms in obſtinate cutaneous complaints.

CCLVI.

Borſet Water.

This water is near that of Aix, and reſembles it. It is of a high temperature, and therefore chiefly employed as a bath, which is done in every form.

CCLVII.

Barege Water.

The Barege waters have a ſlight taſte and ſmell of ſulphur. They have a ſmooth, ſoapy feel, and they render the ſkin, when immerſed in them, very ſupple and pliable, diſſolving ſoap and animal lymph. They are chiefly employed as a bath, and from their detergent nature joined with their temperature, they are conſidered to poſſeſs high powers in reſolving tumours of different ſpecies, in rigidities and contractions of the tendons and joints, and likewiſe in removing cutaneous complaints. The warm bath is therefore uſed both generally and partially, in the form of douche. The internal uſe of this water is praiſed in diſorders of ſtomach and bowels, connected with an acid courſe, and alſo in jaundice, in calculous complaints, and other affections of urinary organs.

CCLVIII.

We have thus conſidered the principal medicated waters in uſe, detailed their leading qualities, and ſtated the principal diſeaſes in which they are employed, with-

out entering into the particular ingredients of which each is composed. This will be better seen at one view, and is well arranged by Dr. Saunders in his late work on this subject, from which the present table is extracted. It will be only necessary to close the account with some general remarks on their contents and mode of operation — Medicated waters are a remedy that act in two ways, 1st, As a simple water; and, 2dly, As an active impregnation. Their operation in the first way was formerly examined; and, as an active impregnation, although the quantity of medicine they suspend is small, yet from the manner in which it is diffused, the activity of its powers is much increased by the more extended surface to which it is applied; and its impregnation is presented in a form which medicine cannot otherwise so easily convey. This is evident from the complicated nature of the several impregnations. But the gazeous products appear the most useful parts of mineral waters. Their inhalation by the lungs was examined in the former class of bodies, and their application given in mineral waters is principally to the stomach. Hence the sudden relief they generally give to this organ, and hence their great advantage in all its complaints. By the temperature of the stomach their principles are unfolded in it, and they act with powers of which we can out of the body form no judgment, and thus the unexpected cures so frequently met with from their use. That their effects on the system at large, as well as on the stomach, are considerable, cannot however be denied, and this appears proved by the sulphurated hydrogen which is smelt under a course of these waters. Every circumstance

indeed ſhews that mineral waters are a mode of combination of the powers of medicine, in a manner ſuperior to what can be accounted for from their known ingredients, and a mode of exhibiting medicine, which is therefore ſuperior to every other in moſt chronic diſeaſes. All the carbonated chalybeates are much increaſed in their powers by their height of temperature; and of all ſolvents the carbonic acid ſeems the moſt proper for this mineral. The ſame takes place in the ſulphurated waters with reſpect to temperature, by increaſing it their powers are rendered much more active. This effect is leſs conſpicuous in the ſaline waters, which depend more on dilution than temperature.

CLIX.

Class III. *Inflammables.*

Inflammables formerly defined, poſſeſs a principle different from that of the two claſſes hitherto examined, and this principle exiſts, in its moſt ſimple ſtate, in three ſubſtances, carbon, ſulphur, and phoſphorus, the combination of which with oxygen forms acids.

CCLX.

Carbon

The diamond and charcoal are the two chief ſources of carbon. In the former it exiſts in a ſeparate ſtate; in the latter it is more compounded. By combuſtion of the former in oxygen by the ſolar rays, pure carbon has been obtained.

'CCLXI.

Diamond.

This ſubſtance is diſtinguiſhed from every other by its

eminent lustre, density, hardness, and transparency. It is found crystallized, generally colourless though sometimes otherwise, and of a varied appearance. Its specific gravity is from 344 to 355, and it is acted upon by no chemical agent but oxygen, at a high temperature. When placed in oxygen gas, and exposed to the solar rays concentrated, its color first becomes dull, and its surface sensibly blackened. When the application is continued, it at length faintly inflames, and requires the continued application of the same power before it is reduced.

CCLXII.

Charcoal.

Charcoal is a black, sonorous, and brittle substance obtained from the combustion of wood, conducted in such a manner, that the free access of the air is not permitted, the constituent principles of the wood are disengaged in new combinations, and the charcoal is the residuum. This substance, unless when red hot, is unchangeable and incorruptible. Hence the common practice to scorch the ends of stakes that are to be driven into the ground, to make them durable, and it has a surprizing effect. We meet with bits of wood so charred, lying at considerable depth in the ground, which are undoubtedly of very considerable antiquity, and the structure is no ways changed; it not only resists the effect of air and moisture, but the most penetrating matters, nor has any thing been found that acts upon it so long as it remains cold.

CCLXIII.

This substance is tasteless and inodorous. It is extremely porous, and from this porosity is capable of ab-

forbing large quantities of the gafes, without fuffering any change of its properties. When heated to the temperature of ignition in contact with atmofpheric air, it burns with a red or white flame, according to the rapidity of the combuftion, and with the extrication of a large quantity of caloric. In oxygen its combuftion is much more vivid, and by this it is generally confumed. The product is an acid, the faturation of carbon with oxygen. Charcoal, therefore, is a compound fubftance, containing carbon with a proportion of oxygen.

CCLXIV.

Another fubftance which contains alfo this principle is the plumbago, or black lead. It is of a black color, foliated texture, foft, and fomewhat unctuous to the touch. It is not altered by expofure to air or water, nor is it altered by fire, fo as to be ufed in making crucibles and furnaces. By long ignition, or intenfe heat, it is refolved into the carbonic acid, with a refiduum of iron. It confifts therefore chiefly of carbon and oxygen.

CCLXV.

The fubftances termed incombuftible coal, refemble plumbago in their difficulty of burning, and they require alfo a larger quantity of oxygen than charcoal for their faturation. The charcoal of animal fubftances is only combinable with oxygen at a high temperatu.e.

CCLXVI.

Sulphur.

Next to carbon, the 2d fimple inflammable body we mentioned is fulphur. It yields a peculiar odor when

heated, and on being rubbed manifests electric powers. It is found in abundance in nature, in various states, or both pure, and in a state of mixture.

Native sulphur is either crystallized, or in compact masses, and in both forms it is found in the neighbourhood of volcanoes. It exists also combined with the metals, and from the combustion of it with iron, it is extracted for the purposes of commerce. Sulphur thus obtained is freed by sublimation from its impurities, and in this state is termed flowers of sulphur. Sulphur is also contained in small quantities, in several vegetable and animal products.

CCLXVII.

Sulphur is naturally tasteless and inodorous. Its specific gravity is 199. It is insoluble in water, and melts at 223 of Farenheit, and at the same temperature it is volatilised.

CCLXVIII.

Phosphorus.

The last of the simple inflammable bodies is phosphorus. It combines with oxygen at the lowest natural temperature, and its product is a peculiar acid. In the mineral kingdom it exists, combined with several of the metals and earths, and it is a component part of many animal products.

CCLXIX.

Phosphorus, in its pure state, is of a flesh colour, and of the consistence of wax. It is at first transparent, but becomes white, and in the sun yellow. It has a specific gravity equal to 1.914. It melts in water at the tempera-

ture of 99. When expofed to atmofpheric air, it emits a white fume of a fetid fmell; and in the dark it is luminous.

At the temperature of 100 its combuftion is rapid, and at 160 it burns with a white flame, and with the emiffion of a large quantity of caloric. Its combuftion in oxygen gas is highly vivid, and it emits a great quantity of light. Though confumed in atmofpheric air by a flow procefs, it requires in oxygen the affiftance of heat.

CCLXX.

Such are the more fimple inflammable bodies; and proceeding on the predominance of this principle alone, without regard to their feparate qualities or origin, we next confider thofe inflammables of a more compound nature.

CCLXXI.

Alcohol.

The firft of thefe that claims attention is alcohol, or as it is commonly named, ardent fpirit. This kind of body has its name of fpirit, according to the practice of chemifts, who give it to all the liquors afforded by diftillation, and of ardent or inflammable, to diftinguifh it from the faline and other kinds of fpirits. It is alfo termed vinous from its origin; and in its pure ftate, rectified fpirit of wine: or when ftill farther purified, alcohol.

CCLXXII.

This liquor is diftinguifhed by poffeffing an aromatic and refinous fmell, a penetrating hot tafte, and an inebriating quality.

CCLXXIII.

Its origin is from all vegetable matters that poffefs a fweet or faccharine fubftance, which, when diffolved in water, and allowed to ferment, produce a liquor, that afterwards, fubjected to diftillation, is alcohol. The conftituent principles of this liquor are carbon and hydrogen, in intimate union.

CCLXXIV.

This liquor differs fomewhat in its qualities, according to the particular vegetable matter from which it has been prepared; and from its being mixed more or lefs with fome oily matter, it acquires peculiar kinds of tafte and flavor.

CCLXXV.

To obtain it perfectly pure it requires repeated diftillations, fo that its water and oily matter may be thoroughly extracted; and this may be alfo facilitated by certain additions during the procefs. Thefe confift in a mixture of dried carbonate of pot-afh, and to remove the flavor of the alkali thus acquired by it, a fmall proportion of alum is added to the laft diftillation.

CCLXXVI.

By fuch means alcohol of a pure kind may be obtained; and while the fpecific gravity of this liquor is to water as 815 to 1000, it may be brought even the length of 791. This is generally determined by the hydrometer, or by its refidue of water after combuftion. Pure alcohol is colourlefs and tranfparent, and is poffeffed of feveral remarkable qualities. It is one of the moft difficult bodies to freeze of any we know. There is hardly any

fluid ſo much expanded by heat or contracted by cold. At 174 of F. it is converted into vapour, and it evaporates ſpontaneouſly, very faſt, and is in every reſpect a volatile fluid. In vacuo it is converted into vapour, in a heat below any of the heats of our atmoſphere; and on this ſome phenomena of the pulſe glaſs depend. It conſiſts of a head, tube, and ball, ſealed up with a quantity of ſpirit of wine, enough to fill one of the balls and a ſmall part of the ſtem; and when held in the hand, with the one end a little higher than the other, the ſpirit of wine begins to boil.

CCLXXVII.

But the chief quality of this fluid, as already noticed, is its great inflammability, which it remarkably diſplays whenever approached by flame, burning with tranſparency, and without the leaſt appearance of ſmoke. From the products of its combuſtion the proportions of its principles are aſcertained, 100 parts of this fluid being compoſed of 2.5 of carbon, 7.8 of hydrogen, and 63.5 of water; ſo that it contains leſs of the principle of inflammability than any other ſubſtance of this claſs.

CCLXXVIII.

This fluid can be mixed in any quantity with water, in which it differs from other inflammables; but the ſpecific gravity of the combination of the two is never the mean of the ſpecific gravities of the reſpective fluids being always greater. This combination is accompanied with a diminution in the capacity for caloric, and hence a riſe of temperature always attends it. The combination of alcohol with water, in an equal quantity, forms proof ſpirit.

CCLXXIX.

Oils.

The next compound bodies of an inflammable nature are oils, whether vegetable or animal; and the inflammable ſubſtances in animals and vegetables are of an oily nature, and differ only in their degrees of fuſibility.

CCLXXX.

Of vegetable oils there are two kinds, the expreſſed or fixed, and the eſſential or volatile. The former are generally contained in the ſeeds and fruits of vegetab'es, at the period of maturity, being extracted by mechanical preſſure, or by decoction in water. They are frequently impregnated with the mucilaginous or extractive matter of vegetables, whence they acquire colour, taſte, and odour. In their pure ſtate they are inſipid and inodorous, and lighter than water. Their conſiſtence is thick and unctuous, and even at times concrete, or they are eaſily rendered ſo by cold.

CCLXXXI.

Expreſſed oil is equally inſoluble in water and alcohol, nor can be volatized by heat, without a change; in which caſe it becomes more mild and limpid, ſeparating a part of its conſtituent principles. Expoſed to a warm atmoſphere, this body acquires a ſharp taſte and diſagreeable ſmell. It is alſo altered in conſiſtence. This change depends on the abſorption of oxygen, termed rancidity; and it can be rapidly produced in it by its expoſure to vital air.

CCLXXXII.

At the point of ignition, oil is converted into vapour, and burns in atmoſpheric air; and the conſequence of

this combuſtion is the extrication of a large quantity of light and caloric. When the acceſs of the air to the ignited oil is not complete, a black ſmoke ariſes, and a quantity of carbon is depoſited. To prevent this, in the forming of candle, a ſlender wick is proper, which draws up the oil by capillary attraction, and readily converts it into vapour or elſe a hollow wick, which allows a circulation of air through it.

CCLXXXIII.

The products of the combuſtion of oil are chiefly water and carbonic acid. Thus a pound of olive oil contains about 12 ounces of carbon, and above 3 ounces of hydrogen.

CCLXXXIV.

The ſecond claſs of oils, or the volatile, is odorous, ſapid, and generally pungent; it varies in its colour, conſiſtence, and odour, and is chiefly obtained by diſtillation. This oil is moſtly of vegetable origin. There are few oily principles found in animals that belong to this claſs; but in vegetables there is a great variety, and all the vegetables in which we can diſtinguiſh a ſenſible odour, are of this kind. It forms the moſt uſeful principle of their compoſition, and is therefore termed their eſſential oil.

CCLXXXV.

Eſſential oils differ from one another in many reſpects; but many of them have not been found applicable to uſeful purpoſes, and others cannot be extracted but with an expence exceeding the value that can be ſet upon them.

CCLXXXVI.

The other qualities poſſeſſed by eſſential oils, beſides odour, are, that ſome of them are very fluid, light, vola-

tile, and ſubtile; others of them are more heavy, requiring more heat to convert them into vapour. Moſt of them, as obſerved, affect the tongue with a ſenſation of a ſharp, acrid, and burning taſte. Some are milder, ſo that it is difficult to give any general rules reſpecting their qualities. The only one is with regard to their weight, that in the colder latitudes they are lighter than water; in the hot they are ſo heavy as to ſink in that fluid. But even this rule is far from being juſt; for the ſame oil appears in different ſtates in this reſpect, as in diſtilling cinnamon. When diſtilled with a gentle heat, it floats on water; but if the diſtillation is conducted with a ſtrong heat, it ſinks: ſo that the rule would appear to be drawn from the dry ſpices from the Eaſt and Weſt Indies, in which the oil is thicker, from the evaporation of the thinner parts.

CCLXXXVII.

Eſſential oils are preſerved with difficulty long in perfection, and the only way is to keep them in veſſels, with glaſs ſtoppers, carefully bound, which are to be kept in a cool place, and ſeldom opened. They become leſs fragrant, leſs fluid, and of a darker colour, which change happens more quickly when they are expoſed to the air, from their abſorption of oxygen; and they frequently depoſit, in conſequence, cryſtals of an acid nature. To reſtore them to their former ſtate, it is common to diſtil them with water, in a gentle heat.

CCLXXXVIII.

The diſtinguiſhing property then of eſſential oils is their volatility, ſo that in the heat of boiling water they raiſe viſible ſteams, and evaporate copiouſly. This vola-

tility is gradually impaired by keeping, as in the oil of turpentine, which suffers it very quickly. Distilled with water, a portion of essential oil is procured, much improved, while what remains is thicker, darker, and less odorous, and the volatility can be increased beyond what it was at first. The diminution of the oil is most apparent without water, each time a small portion of the water separates, and a thick resinous matter remains, or carbonaceous substance, and by degrees the whole of the oil is decomposed.

CCLXXXIX.

Essential oils, when heated in contact with atmospheric air, are more easily inflamed than the exprest oils. Thus with the oil of turpentine, the wick of candle is prepared for lighting quickly. They yield also more water by their combustion. Hence they contain a larger proportion of hydrogen than the exprest oils, which is perhaps the cause of their greater volatility and inflammability.

CCXC.

Essential oils dissolve in water, in a certain proportion, so that their more volatile and odorous part becomes combined with it, and the fluid, in consequence, acquires a degree of the pungent taste and odour of the oil, and displays a whitish appearance.

CCXCI.

In their action with the simple inflammable substances, the oil of cloves produces a liquid with phosphorus, which emits a luminous vapour; and when it is rubbed upon the skin of the hands or face, it makes them appear luminous. These oils also dissolve sulphur, reduced to a fine powder, the oil being heated. The solution is of a red colour, and

acquires a thicker confiftence; it is called balfam of fulphur, of which there are feveral kinds.

CCXCII.

The relation of fpirit of wine or alcohol to thefe oils, is alfo worthy notice. It diffolves moft of them with eafe, and in confiderable quantity, forming a tranfparent homogeneous fluid. This is the cafe with all the aromatic oils, without exception; only fome can be diffolved in greater quantity. The fpirit of wine has a greater difpofition to diffolve thofe that are thick and refinous, than the more fluid, fubtile, and volatile. A feparation of the oil, in this folution, is eafily made by the addition of water. By diftillation of alcohol with thefe vegetables containing effential oil, diftilled fpirits are formed, which are the moft delicate preparation; diftilled with water, more of the oil is diffolved; diftilled with fpirit of wine, its fragrant part only is carried off.

CCXCIII.

Thefe oils of vegetables are fecreted juices, lodged in particular veffels; fometimes in the bark, as in cinnamon; fometimes in the root, as in the plant that yields the true camphor; fometimes in the wood, as cedar; fometimes in the leaves, as mint, balm, fage; fometimes in the flowers, as the mofs-rofe; fometimes in the feeds or fruit, as in a great variety; fometimes in the bark or rind, as in the oranges and lemons, of which the external furface is quite rough, with little cells that contain the aromatic oils, which can be burft by fqueezing the rind; and if this is done oppofite to a candle, the oil is thrown acrofs it, and forms fo many jets of flame.

CCXCIV.

In general, they are extricated by means of heat, and diſtilling them with water; and in doing this the vegetable ſhould be macerated for ſome time in the ſtill, with a proper quantity of fluid, and then diſtilled with a moderate heat. During the maceration the water penetrates, and opens the little repoſitories, and the heat of the boiling water converts the oil into vapours, which are carried over more copiouſly by thoſe of the water than they would otherwiſe riſe of themſelves; ſo as ſoon as the water is condenſed it becomes milky, the oil condenſing along with it, in minute drops collected into larger, which riſe to the ſurface, or fall to the bottom. This operation is the only means of applying heat to vegetables, in order to extract the oils of this kind; for their volatility is but moderate, requiring the full heat of boiling water to convert them into vapour; and we cannot apply this heat to all the parts of a vegetable ſubſtance in any other way than by immerſing it in boiling water. It is put by itſelf into the ſtill, before the upper part of it is in due degree of heat, and by the water the heat is raiſed to the degree neceſſary to convert the oil into vapour over the whole of the ſubſtance, at the ſame time; and theſe vapours that would aſcend more difficultly, are puſhed over more quickly by the aſcending vapours of the water. It is true that a neceſſary conſequence is, that a proportion of the oil is diſſolved by the water, which it is impoſſible to recover again; but when the operation is done for the ſake of the oil, the ſame water can be employed in the next diſtillation, and the water is capable of receiving only a

certain quantity of the oils: ſo it will diſſolve more of the oils of the ſecond parcel.

CCXCV.

From ſome vegetables, as lemon and orange, this oil can be obtained in a mechanical way, as being lodged in the rind; and that by either ſqueezing the rind, ſo as to burſt the cells that contain it, or by rubbing the rind upon a loaf of ſugar, the roughneſs of which breaks up the cells, and the oil is imbibed by its pores. The ſugar thus moiſtened may be ſcraped off, and this operation continued, till a proper quantity of oil is obtained, mingled with the ſugar; and this may be very uſeful on many occaſions, as the ſugar is not an unfit ingredient to be added to the mixture, in which theſe oils are commonly uſed.

CCXCVI.

Camphor.

This is a ſubſtance that poſſeſſes properties that are conſidered by chemiſts as peculiar. That it is an aromatic oil is plain, from the greateſt number of its qualities, and alſo from its origin. It is produced from a ſort of laurel, a native of Japan. It is depoſited in particular veſſels, as the aromatic oils are; and it is extracted in the ſame manner, by expoſing it to the heat of boiling water. It is likewiſe depoſited from ſeveral eſſential oils, when they are long kept.

CCXCVII.

Camphor is ſolid and tenacious, of a white colour, and ſemi-tranſparent. It poſſeſſes a ſtrong fragrant odour, and a warm pungent taſte, like the aromatic oils.

It is fo volatile, that it quickly lofes weight when it is expofed to the air; and at a very moderate increafe of temperature, it fublimes unchanged. It appears to be a volatile oil, rendered concrete by carbon, and therefore highly inflammable. It is eafily foluble in fpirit of wine, and eafily feparated again from it by water. It unites with fulphur, in a gentle heat, and its relation to the faline bodies fall to be afterwards confidered.

CXCVIII.

Balfams and Refins.

Under this divifion of aromatic oils may be comprehended alfo the balfams and refins, as nearly refembling them. They are found in various vegetables, and are fecreted juices, depofited in particular veffels of the plants.

CCXCIX.

In general, when applied to the tongue, they produce the fenfation of tafte with more or lefs pungency and heat. They are all more or lefs inflammable, and produce much foot during their combuftion.

CCC.

Refins are oils rendered concrete by their combination with oxygen. Balfams are refins combined with effential oil, and a principle convertible by oxygen into an acid, of the benzoic kind.

CCCI.

Both fubftances diffolve readily in fpirit of wine, and are again eafily feparated by water, in which they refemble the effential oils. The chief diftinction is in the degree of fluidity and volatility. Many are extremely folid and

very hard. The greater part of the balſams have a ſenſible degree of fluidity; ſome of them are nearly as fluid as ſome of the eſſential oils, while the reſins are ſolid and brittle. In the ordinary temperature of the air with heat, they melt into an oily fluid, not to be diſtinguiſhed from what is called a balſam; ſome are brown, ſome reddiſh, ſome more tranſparent, and their degree of fluidity is various. Indeed the ſame individual balſam varies in its conſiſtency, by degrees. If long kept, unleſs pains are taken to confine the volatile parts, it ſuffers a diſſipation of them.

CCCII.

In ſpirit of wine theſe ſubſtances are, in general, more ſoluble. Boiled in water, they are in part converted into vapour, and diſperſe their odour all around. If the vapour is condenſed, they form a perfectly fluid, fragant, volatile, aromatic oil, while the remaining matter is leſs odorous than the balſam was at firſt. It varies, and is commonly found to be changed into a perfect reſin, and brittle in the ordinary heat of the air. If this is ſubmitted to inflammation, there is obtained a ſmall quantity of aromatic oil; but as the greateſt part has little volatility, the heat ſcorches and changes the arrangement of their particles, forces off oily vapours that are called empyreumatic, and leaves a reſidue of carbonaceous matter.

CCCIII.

A great variety of vegetables contain balſams and reſins; ſome of them are more ſoluble in ſpirit of wine, and ſome are difficultly ſoluble in it. Hence the different kinds of them, according to their different degree

of tranſparency, want of colour, &c. prove uſeful in a variety of arts.

CCCIV.

The balſamic and reſinous ſubſtances are, in general, ſecreted juices, and are found in the parts of the vegetable. The proceſs, by which they are found, is not the ſame with that employed for the oils. The general manner in which they are obtained, is by cutting the vegetable in different places, ſo as to occaſion the juices to be ſhed by bleeding, and it even happens ſpontaneouſly, in conſequence of an overfulneſs of the veſſels occaſioning them to burſt. Theſe juices iſſue out as fluid as an aromatic oil; but iſſuing out but ſlowly, they ſuffer an evaporation of their more ſubtile parts, and gradually increaſe in thickneſs and conſiſtency, till they acquire the conſiſtence of a balſam, or the ſolidity of a reſin.

CCCV.

There are many of theſe ſubſtances that are applied to various purpoſes in the arts, as well as being made uſe of in medicine. Many of them that are of great tranſparency and hardneſs, when diſſolved in ſpirit of wine, compoſe varniſhes, which ſpread on wood, leave the reſin, while the fluid that held it diſſolved, is evaporated.

CCCVI.

The expreſſed, or fixed oils already noticed, deſerve, in concluding the volatile or eſſential ones, to be proſecuted ſomewhat farther in detail.

The moſt perfect oils of this claſs are mild, free of taſte and ſmell, and unctuous and greaſy to the feel. When compared with the aromatic oils, the greater num-

ber are ſluggiſh and thick. They are lighter than water, and are more volatile than the aromatic oils, ſo that they do not ſo readily ſuffer the ſame change when expoſed to the air; but if with the expoſure heat concur, as that of the ſummer or of the blood, they acquire an offenſive ſmell, a thicker conſiſtence, and a great degree of acrimony. Thus they irritate the nervous ſyſtem, and there is no ſubſtance which is more ready to produce noxious effects, when taken into the body, than oils in this ſtate.

CCCVII.

Such oils poſſeſs a great difference in their diſpoſition to be affected by heat. They are not near ſo inflammable as the aromatic oils, and they have not the leaſt degree of volatility in the heat of boiling water, or in ſome degrees above it. Neither can they be volatilized by heat unchanged. At a temperature below 600 of F. they remain fixed, but nearly at that temperature they are converted into vapour; but the oil thus condenſed has loſt its mildneſs, and has become more limpid and volatile, a portion of carbon being likewiſe depoſited.

CCCVIII.

Some artiſts have occaſion to boil lintſeed oil for painting; but it muſt be done in the external air, from the riſk of the oil boiling over, and ſetting fire to the place where it is; but at the ſame time attention muſt be paid to the ſtate of the weather, that it be ~~clear~~, as the ſmalleſt drop of water falling into the oil, would make it boil over with the greateſt violence.

CCCIX.

Unctuous oils differ from the aromatic in their difficult

ſolubility, as they neither diſſolve in water nor ſpirit of wine. With regard to inflammable ſubſtance, theſe oils diſſolve phoſphorus, and ſome of them form luminous liquids, like the aromatic oils. Sulphur is alſo diſſolved by them. The oil is put into an iron veſſel, adding $\frac{1}{6}$ or $\frac{1}{4}$ of the weight of ſulphur. The oil is heated till the ſulphur melts, when it communicates a darker colour to it. If $\frac{1}{4}$ part is diſſolved, it forms a gelatinous maſs of $\frac{1}{6}$ only; it is of the conſiſtence of a balſam, and is called the balſam of ſulphur. Oils cannot be made to diſſolve charcoal, nor do they mix, as already obſerved, with ſpirit of wine.

CCCX.

Some of the ſpecies of unctuous oils are diſtinguiſhed by particular qualities. Some ſhew a little affinity with the aromatic kinds containing a volatile principle, the preſence of which is neceſſary to their fluidity; and as it evaporates, the oil becomes ſolid. The upper part, from the abſorption of oxygen, has a thick film formed on it. When theſe oils are ſpread on the ſurface of a body, as wood, they acquire a particular conſiſtence, and compoſe a thin covering of a tough varniſh.

CCCXI.

Spermaceti.

Spermaceti is a concrete oil, extracted from a ſpecies of the whale. It is perfectly mild and inſipid. It is indiſſoluble in water. It has a conſiderable degree of ſolidity, and not having the greaſy ſoftneſs of the other fats, it does not leave a greaſy ſtain upon clothes; but when cold it can be rubbed off. It melts in heat below boiling water, and it congeals like water congealing

into ice; and without paſſing into any intermediate ſtate of ſoftneſs, it forms a maſs that is white, ſomewhat tranſparent like alabaſter, and of a foliated ſtructure, like talc. It is mixed with the fat of a particular ſpecies of the whale, is fluid in the animal, but congeals when expoſed to the air; it is ſeparated from a quantity of fluid oil mixed with it, by colature, by putting the matter into bags, when the fluid oil is drained away, and expoſed to a violent preſſure, it it ſqueezed out; the ſpermaceti is then found in the form of little tranſparent ſcales. It is next melted with a ſmall quantity of cauſtic alkali, which unites with the remaining oil, and changes it into a ſoap, while the ſpermaceti is not diſpoſed to unite with the alkali in the leaſt.

CCCXII.

Spermaceti burns with a very white flame, and riſes totally, if diſtilled on a violent fire, aſſuming a reddiſh tinge, and loſing its natural conſiſtence by repeated diſtillations. Alcohol diſſolves it by the aſſiſtance of heat, but lets it fall as it cools. Its ſolution takes place alſo by the fixed and volatile oils.

CCCXIII.

Bees' Wax

Is connected to the fixed oils, in the ſame way as camphor is to the volatile. It is produced in the antheræ of flowers, from whence it is collected by the bee. It is yielded alſo by the fruit and leaves, and is ſometimes contained in their juices. It differs from ſpermaceti in having a greater degree of ſolidity. When diſtilled the greater part riſes in an oily form, ſome part in the form

of a liquid oil, the greateſt part having ſome degree of ſolidity, and the maſs is then termed the matter of wax, and which has a leſs offenſive ſmell than moſt of the empyreumatic oils. It is inflammable, and the products of its inflammation are water and carbonic acid; and from the quantities of theſe the proportions are calculated to be 13 parts of carbon and 2 of hydrogen.

CCCXIV.

Lac.

A ſubſtance of a ſimilar origin is lac. It is a kind of wax, collected by red-winged ants in the Eaſt Indies, from flowers, which they tranſport to the ſmall branches of the trees where they make their neſts. It is imported in ſmall ſticks, named ſtick lac. The branches of the trees are covered over with it to a conſiderable degree of thickneſs. It forms an unequal covering over the ſtick, of a dark colour or orange colour. It is full of cells, but more irregular than thoſe of the bees, and at the bottom of the cell there are the remains of the inſect; but it is prepared before it comes to the ſhops. The lac is beat off, and ſteeped in water, to extract the colouring matter which is uſed in dying. What remains is called ſeed lac, conſiſting of ſmall grains into which the lac breaks when taken forcibly off the ſurface of the twigs. On other occaſions the heat is applied to it in a greater degree, in order to get more of the colouring matter, which makes it melt. It riſes to the ſurface, is then ſkimmed off the water, and cooled in plates of metal, when it is called ſhell lac.

CCCXV.

This ſubſtance reſembles bees' wax in ſeveral parti-

culars, but it has a greater degree of hardnefs. The greater part of it diffolves in fpirit of wine, and forms a remarkably hard varnifh, which is capable of receiving a very fine polifh; but from its dark colour, it is incapable of being employed to ftain works that have a variety of colours.

CCCXVI.

Such are the chief remarks to be made on the fixed or unctuous oils, and on the fubftances that moft refemble them. On their ufe and origin, it may be obferved, that though the aromatic oils are moft precious, the fixed oils are moft valuable and ufeful. They are produced in great quantity, and hence are not high priced. They are a neceffary part of diet in all parts of the world, in the form of butter from milk; of olive oil; from vegetables, &c. They alfo afford light in the night-time, and they are one of the conveniences that contribute to render fome climates inhabitable. In Lapland they keep their habitations warm by means of them. The lamp conftantly burning, is the principal part of the houfehold furniture. They are neceffary, as we fhall find, in making foap and diminifhing friction in machines, and many of them are ufeful as paints and varnifhes, to defend wood from the air and water.

CCCXVII.

Animal Fat.

Fixed oils are not confined to vegetable fubftances, but alfo abound in the bodies of animals. In fifhes they form a covering, and preferve their heat in the denfe and cold element they inhabit. Thefe oils are immediately under the fkin; they are both in vegetables and animals fecreted juices; they are found in vegetables in different

parts, and they are extracted by various operations; generally by expreffion from feeds. Thus lintfeed is ground down to a meal, and expofed in a ftrong hair bag to violent preffure, and a little heat is employed to give a greater degree of fluidity and facility to the expreffion. In other cafes, when it can be in fome meafure diffolved in water, the fubftances are infufed in this fluid, as in the oil of olives, &c. The oil feparates, and rifes to the top, and all the oils of animals, as that in the cellular membrane, are foluble in water by coition; and this method is the moft convenient for extracting them.

CCCXVIII.

Animal oil, diftinguifhed by the name of fat, is of a white colour, fometimes yellow, of an infipid tafte, and of various confiftence in different animals. It differs both in the individual, as well as in the part of the body which produces it. On expofure to the air it becomes rancid, from the abforption of oxygen. It is alfo decompofed by heat, and from this decompofition there is produced an acid liquor, an acrid empyreumatic oil, and carbonated hydrogen, having a refidue of charcoal. The acid liquor has been fuppofed a peculiar one, termed the febacic acid. When obtained pure it is fluid and colourlefs, has a pungent odour, and a fharp acid tafte. It is decompofed by heat, carbonic acid being difengaged, and charcoal remaining.

CCCXIX.

When oils are diftilled with a heat above that of boiling water, fo that they are made to affume the form of vapours, they never fail to undergo a change. They become highly acrid and ftimulating, as well as fetid

and diſagreeable. In this ſtate they are termed empyreumatic oils, and are diſtinguiſhed into four varieties, viz.

1. Thoſe produced from the balſams and reſins.

2. Thoſe from the fixed oils.

3. Thoſe from the vegetable ſubſtances that do not contain a formed oil. And

4. Thoſe from animal ſubſtances that are not of an oily nature.

CCCXX.

The firſt diviſion has, along with the burnt and diſagreeable flavour, ſome of the odour of the aromatic oil. The balſams and reſins always give out a quantity of aromatic oil, which is mixed with the empyreumatic from the more fixed part of the reſinous matter, ſo as to communicate ſome degree of the particular flavour.

The ſecond diviſion has always an odour more or leſs reſembling that of the ſnuff of a candle or lamp; a quantity of unctuous oil continues to evaporate from the wick, and the ſteams affect our organ of ſmell.

The third diviſion has more or leſs the odour of tar, and is not diſtinguiſhable from it; it is attended with the ſmell and odour of the wood that is burning.

The fourth kind has always an odour reſembling that produced by the burning of bones, and other animal ſubſtances.

CCCXXI.

Theſe oils, as firſt diſtilled, are always dark coloured, and have a conſiderable degree of thickneſs and viſcidity. They are eaſily ſoluble in ſpirit of wine, and miſcible in ſome meaſure in water, and they want the lubricating

opacity of the unctuous oils. If they are repeatedly diſtilled they acquire a greater degree of tenuity, fluidity, and volatility, and the dark colour goes off. There are many of them that can be rendered as colourleſs, fluid, and volatile as ſpirit of wine. They then mix more readily with water, which acts chiefly on their more volatile parts. The moſt fetid of the empyreumatic oils are thoſe from animal ſubſtances that are not of an oily nature. Some of them have been highly recommended in medicine, as powerful anodynes; but the trouble of preparing them, and the difficulty of preſerving them, have made them be leſs attended to. They muſt be diſtilled five or ſix different times, and the oil put into a clean veſſel each time, which is attended with conſiderable trouble and expence, as it is difficult to free the veſſels of the thicker matter remaining after the diſtillation, and the exceſſive fœtor of the oil renders the operation very diſagreeable; and when they are prepared, they are liable to depravation by keeping.

CCCXXII.

But there are ſome kinds applied to more extenſive uſes, as tar. It is the empyreumatic oil of pine and of different kinds of fir trees. It is expelled from them by heat, and condenſed haſtily, ſo as to obtain the greateſt quantity of this oil; and as theſe trees all contain a quantity of balſamic matter and aromatic oil, the tar has that adhering to it.

CCCXXIII.

Bitumens.

The laſt diviſion of inflammable bodies comprehends the bitumens, which are generally of a ſtrong ſmell, are fluid,

ſoft, or ſolid, and afford by diſtillation an empyreumatic oil. They are found in three ſtates, exuding from crevices, floating on waters, or forming ſtrata in the earth. They conſiſt of the ſame principles as vegetable matter, of carbon, hydrogen, and oxygen; and there are often mixed with them the remains of vegetable matter. They ariſe, therefore, from the ſlow decompoſition of vegetable ſubſtances lodged in the earth, or they depend on the action of heat, without the acceſs of air.

CCCXXIV.

Naphtha and Petrolea.

The naphtha is an oily liquor, limpid and colourleſs, of a penetrating ſmell, volatile, and highly inflammable, having a ſpecific gravity of 708 to 847. It will burn on the ſurface of cold water, and it does it with a ſmoke like all other oils. A liquor of this kind is generated from particular ſprings and wells in Perſia, and in the duchy of Modena in Italy. Others, inferior to this, more frequently occur under the name of petrolea, of a brown or black colour, and leſs agreeable odour, in various parts of Europe, in the crevices of rocks, in ſprings and wells. The aſphaltus is another ſpecies of the ſame, ſolid and brittle, and altered, perhaps, by expoſure to the air. It melts by heat and is decompoſed, affording an empyreumatic oil, carbonated hydrogen, and carbonic acid. None of theſe varieties, when burnt, leave any earthy reſiduum.

CCCXXV.

The bitumens, in conſiſtence, reſemble the vegetable balſams. Thoſe of them that are more ſubtile than the kinds deſcribed, ſo rarely occur, and are ſo coſtly, that

ſew experiments have been made upon them. The more fluid ones float on ſpirit of wine, and readily diſſolve in it. The thicker kinds derive their conſiſtence from a greater proportion of ſolid matter. When diſtilled they become like the fluid kinds, acquire a greater tenacity, tranſparency, and volatility. Upon the whole, the different varieties reſemble the empyreumatic oils, and are obtained by heat from the ſolid bitumens; of theſe there are two kinds.

CCCXXVI.

The firſt is the amber or ſuccinum, which is a bituminous concrete, of a yellow or brown colour, and more or leſs tranſparent. In its colour, however, there is conſiderable variety; ſome pieces being clear and tranſparent, ſome opaque and whitiſh, ſome dark coloured; the moſt valued ſpecimens are of a pale yellow colour. On being ſlightly rubbed, it acquires electric powers; only a ſmall portion of it is diſſolved by ſpirit of wine. It gives the moſt remarkable phenomena when expoſed to heat. Being rubbed, the odour of it that exhales reſembles the aromatic reſinous ſubſtances, and is increaſed. In a greater heat it acquires a brown colour, emits ſome ſteams, and undergoes a ſtate of fuſion. It then becomes quite dark and opaque, and it is employed in this ſtate in the compoſition of ſome varniſhes. At the ſame time it emits very penetrating vapours, burns with a greyiſh flame, and leaves a coaly reſiduum.

CCCXXVII.

When this ſubſtance is diſtilled, the empyreumatic oil [illegible]ced is moſtly thick, and of a blackiſh colour, and has a heavy, penetrating odour. When it is repeatedly

diſtilled it becomes more fluid and tranſparent, and can be rendered quite limpid; in which ſtate it is ſaid to reſemble the finer kinds of petrolea, particularly the naphtha. It is then termed rectified oil of amber.

CCCXXVIII.

The origin of amber has been much diſputed, whether it is originally a foſſil, or is produced from vegetable matter. The only reaſon to imagine it is entirely a foſſil body is, that it is found at ſome depth below the ſurface under certain ſtrata. The greateſt part that we have comes from the Baltic. A conſiderable quantity is found floating on the ſea on theſe coaſts, being waſhed out of the ſoil by the agitation of the waves, when they penetrate through different ſtrata, firſt through one containing foſſil wood, variouſly compacted together; under this a ſtratum of vitriolic minerals; below this the amber is found diſperſed, in various ſizes; but when it is examined, we find manifeſt proofs of its having been produced originally at the ſurface of the earth.

CCCXXIX.

Ambergriſe.

The ſecond of the ſolid bitumens is ambergriſe. It reſembles amber in ſeveral chemical qualities. It is a light aſh-coloured body found on the ſea-ſhores in the Eaſt Indies. It is opaque, and of a granulated ſtructure. It has a light agreeable odour, melts with a gentle heat, without ſuffering any change; and, if farther heated in cloſe veſſels, it gives an oil like that of amber. It alſo diſſolves in ſpirit of wine, by means of heat, and is uſed in the compoſition of perfumes.

CCCXXX.

The origin of this ſubſtance is uncertain. It appears to be ſomewhat ſimilar to that of amber. It is found in maſſes, from one to a hundred ounces. The greateſt quantity is found in the Indian ocean; but we alſo meet with it in our own and in the Northern Seas. It is found likewiſe adhering to the rocks, and in the ſtomachs of the moſt voracious fiſhes; theſe animals ſwallowing at particular times every thing they happen to meet with. It has been particularly found in the inteſtines of the whale, and moſt commonly in ſickly fiſh, being ſuppoſed the cauſe or effect of diſeaſe. We often find in it relicts of animal and vegetable ſubſtances, the bones and beaks of birds, and inſects; and as it reſembles bees-wax, melting like it, it would appear that it has been originally bees-wax, which having been buried under the ſurface of the earth, or having floated a long time on the ocean, has undergone a conſiderable change; and we know the amazing quantity of bees-wax and honey that is ſometimes collected by bees, in their wild ſtate, as in America. In old trees quantities have been found, ſufficient for filling ſeveral hogſheads; and in rocks and caves along the ſea-ſhore, quantities may be gathered together, and by being buried, or by floating on the water, they may undergo a change, ſo as to be converted into this ſubſtance.

CCCXXXI.

Coal.

The laſt of the ſolid bitumens is coal, which is well known as a uſeful fuel. It is of conſiderable variety, and differs from the preceding ſubſtances in containing

earthy and carbonaceous matter; the different proportions of which give rise to its different varieties. It burns with flame and smoke, and leaves a residuum of ashes. Exposed to heat, in close vessels, it affords an empyreumatic oil, carbonated hydrogen, carbonic acid, ammonia, and sometimes sulphuric acid; the residuum is carbonaceous matter, and when burned to whiteness, its ashes are chiefly argillaceous earth, with oxyd of iron.

CCCXXXII.

Coal is generally found in extensive strata, and the chief varieties of it are, 1. The common Parot coal; 2. The fat, or blacksmith's coal; 3. The Kilkenny, or blind coal; and 4. The candle coal.

CCCXXXIII.

The Parot coal differs from the fat coal, in being more inflammable, and in burning with a much more copious flame. Exposed to heat, in close vessels, it gives out a quantity of empyreumatic oil, which, by repeated distillations, acquires a great degree of tenuity. At first it is thick and very black, but it becomes light coloured, and so volatile as to take fire on the least approach of flame; on the surface of water thus resembling the naphtha and petrolea, which were formerly employed in the art of war, spread on the surface of water, and set on fire, in order to burn the enemies' ships.

CCCXXXIV.

The fat coal contains a great quantity of inflammable matter; but in so volatile a state that it requires some art to blow it up, as it is disposed to undergo a sort of fusion. The small pieces unite, and concrete together

This is a valuable property, and which renders the English coal ſo eſteemed in commerce, becauſe in the working and ſhipping it is not liable to any waſte and decay. The duſt of it proves juſt as uſeful as the ſolid pieces, whereas the Scots coal, of the common kind, is cut, diſpoſed to bake together, and the duſt of it extinguiſhes the fire, like ſand. But theſe firſt unite together, in conſequence of the partial fuſion, and form large maſſes, which are afterwards broken, in order to animate the fire.

CCCXXXV.

The blind coal is a ſort of natural charcoal, as formerly noticed. By its external appearance it is not to be diſtinguiſhed from the other coal; but in the fire there is a great difference. It does not give out the ſmalleſt appearance of flame, but contains the inflammable matter in a more fixed ſtate. Expoſed to heat, in cloſe veſſels, it does not give out any empyreumatic oil. Some change has been produced to form this coal, by the application of ſubterraneous heat upon coal of the common kind, as the diſſipation of its more volatile part, and a vein of coal cinder is actually found near the town of Ayr.

CCCXXXVI.

On examining the extenſive ſtrata of coal, we find every reaſon to conclude that it is of vegetable origin. We meet very frequently with appearances in it ſo much reſembling thoſe of the charcoal of wood, that there is no room to doubt that theſe maſſes have been formed from pieces of wood, that have undergone ſuch a change as to give the appearance of charcoal. We ſee the fibrous appearance of the charcoal, and that it poſſeſſes the

qualities of it; and we obferve that it is found in the neighbourhood of ftrata, formed by a difpofition for water. At leaft, in this part of the world, confiderable quantities of coal and free-ftone are intermixed, which laft is formed from fand, arranged by water. Befides we find large collections of wood, under the furface, ftill retaining its principle, as near Exeter in Devonfhire; only it is fo bituminous that it cannot be made ufe of for ordinary fuel, and is only employed for burning lime: and in no other parts do we find fuch amazing quantities of wood or trees, compacted together, fo as to form very thick and extenfive ftrata.

CCCXXXVII.

These facts plainly fhew, along with many other phenomena, that this globe has undergone great changes; that what was once above the furface is now buried at a great depth below, and what was at a great depth is now expofed to the air. So we find reafon to conclude, with regard to the foffil inflammable fubftances, that they have all derived their origin from vegetables. We find traces of thefe in amber, &c.; and with regard to the fluid inflammables, they refemble the empyreumatic oils, and are probably produced by the deftruction of inflammable fubftances, by fubterraneous fires; and we find them in countries that abound with volcanoes, as in Italy, where the different kinds of naphtha and petrolea iffue from the crevices of rocks; and float on the waters of particular fprings, and the whole of the country has fubterraneous fires at prefent, or the marks of fires that have exifted before.

CCCXXXVIII.

From this view of inflammable ſubſtances, we find, that their baſe conſiſts of one of three ſimple bodies, carbon, ſulphur, or phoſphorus; and that theſe ſimple bodies are united with various extraneous matters. Thus diamond conſiſts of carbon, in its pureſt ſtate; charcoal conſiſts of carbon, with a proportion of oxygen; plumbago is carbon, with a proportion of oxygen and iron. Proceeding farther, we find, alcohol conſiſts of a union of carbon and hydrogen; that the oils contain carbon, in a very conſiderable proportion; that in the fixed oils it is combined with mucilage, and in the volatile ones with aroma; that camphor is a volatile oil, rendered concrete by its carbon; that wax is formed of carbon, in a large proportion; and that the bitumens conſiſt alſo of a large ſhare of this principle, with a contamination of earth and other matters.

CCCXXXIX.

Sulphur, again, the ſecond of the ſimple inflammables, may be conſidered as the grand mineralizing agent; and its combinations, therefore, will appear in a claſs of bodies we are afterwards to conſider.

Phoſphorus, the laſt of the three, compoſes the principal baſe of the hard parts of animals, particularly the bones, and is found in greateſt abundance, and is moſt eaſily procured from the bodies of animals.

Thus each of them may be ſeparately conſidered as the proper inflammable baſe of the vegetable, mineral, and animal kingdoms, though not excluſively confined to theſe.

CCCXL.

We have thus examined the claſs of inflammable bodies,

both in their ſimple and more compound ſtate. This claſs we find highly important in medicine; of the ſimple inflammables, carbon and phoſphorus enter largely, as conſtituent principles, into the animal body; and of the compound ſubſtances, the unctuous oils do the ſame.

Carbon is that principle which is the baſe of vegetable matter, and which is transferred to the animal body from that ſource. Its extrication, therefore, by the proceſs of reſpiration, is gradually and conſtantly taking place, by the abſorption of oxygen decompoſing it, in order to allow complete animalization to enſue, and the real animal principle, or azote, to prevail.

Phoſphorus, again, is a particular conſtituent of the bones, as carbon is of the ſofter parts; and they conſiſt almoſt entirely of phoſphate of lime, with a fibrous parenchyma.

Sulphur is contained in very ſmall proportion in animals; but, at the ſame time, it is much uſed in medicine.

CCCXLI.

As a medicine, ſulphur is diſtinguiſhed by its inſolubility in the animal fluids, by its ſpecific action in pſoric affections, and by its power of diminiſhing the activity of other medicines of a metallic nature. The firſt ariſes from its entering ſo little, as a conſtituent part, into the principles of the animal body; the ſecond is a conſequence of its highly penetrating and diffuſible nature, acting as a powerful ſtimulus on the extreme cutaneous veſſels, and hence applied in any manner it is equally effectual; and the third is by reaſon of its abſtracting from ſuch metallic remedies that part of the oxygenous principle

which gives them oxydation, and on which their activity depends.

CCCXLII.

Carbon has of late been introduced as a medicine, in its compound ſtate, or in the form of charcoal, againſt internal hæmorrhage and external ulceration. In the firſt caſe it is given in powder, and will no doubt be ſucceſsful in arterial hæmorrhage, by leſſening action, and abſtracting that principle to which the change of the fluid in its paſſage through the pulmonary veſſels, is owing. In ulcerations of an irritable, painful nature, it will ſoothe uneaſineſs, and diſpoſe to the formation of fibrine, or ſolid, in the part.

CCCXLIII.

Alcohol is a fluid largely employed in medicine, both ſimply and as a ſolvent of other ſubſtances. It poſſeſſes highly ſtimulant powers, and imparts their active principle to all the variety of wines of vinous and ſpirituous liquors in uſe. Its proportion in theſe different liquors varies; but its operation is always to affect the nervous ſyſtem in a powerful manner, and to induce that debility, as a ſecondary effect of its action, which we term intoxication, and which powerfully undermines the ſprings of life. The dietetic uſe of alcohol, in its different forms, has thinned ſociety more than either peſtilence or the ſword; and the impaired conſtitution of modern age marks ſtrongly the baneful conſequences of its influence.

CCCXLIV.

Oils, the next diviſion of this claſs of bodies, are much allied to the animal conſtitution. Thoſe of the volatile

kind are chiefly used in the form of distilled waters, or combined with alcohol, termed spirits, as rendering it more agreeable. Their operation, therefore, on the body differs in no respects from it, and cannot be considered as having, in the small proportion in which they are combined, the real operation of an oil. The fixed oils, however, admit a more general application, and they are employed in medicine largely, both externally and internally. By their lubricating and emollient qualities they remove tension, pain, and spasm; and by their chemical combinations they may be considered as acting farther, and lessening the activity of the oxygenous principle, in certain states of disease. Thus, when the decomposition of carbon and hydrogen is too rapid, by the different excretions and absorption of oxygen is in excess, oils will be properly used, to lessen this effect. In some climates they are both employed largely in diet, and also their external application to the surface, is attended with the most salutary consequences. Too little observation, however, has been made on this subject, to enable us to form any full opinion respecting it. In all cases of abrasion of surface, the use of oils, in the form of unguent, has been very general; but they are more suited to the active inflammatory states of local disease than to the chronic; and in the latter they do not even form, in a great number of cases, a proper medium for the application of other remedies.

The use of oils has been lately recommended in one peculiar disease, which has baffled the healing art, hydrophobia; and it is recommended both internally, in liberal doses, and also to be applied externally, by general and strong friction of the surface.

In all cafes where oils are ufed internally, they require to be taken in a combined ftate; the ftomach is unable to digeft them pure.

CCCXLV.

Camphor is one of the moft powerful remedies in medicine, and it is ufed both externally and internally, in a variety of diforders. From its connection with the effential oils, it is clearly, in fmall dofes like them, a powerful ftimulant. Hence in folution it forms a fuccefsful rubefacient, in cafes of external pain or fpafm. In large dofes, however, it becomes a ufeful fedative and antifpafmodic; and for this purpofe it is employed for urinary affections, particularly where irritation arifes from the abforption of cantharides; in which cafe it is faid to act like a charm. In contagious diforders, as putrid fever, it has proved alfo a ftrong antefceptic; but to its fedative qualities in mania, much more has been afcribed than to any other remedy; and that fuccefs has here frequently attended its exhibition there can be no doubt.

CCCXLVI.

The refins and balfams are equally external and internal medicines. The latter have been confidered as fpecific in ulcerations of the lungs and urinary organs; the former are more heating and inflammatory. The ufe of both is much circumfcribed in modern practice.

CCCXLVII.

The ufe of fpermaceti, formerly in much repute, is now little employed in medicine. Its only quality is as a foftening remedy in foothing irritation; hence it is

exhibited wherever abrafion of the paffages takes place, as in cattarrh, or ulceration of parts, particularly of the lungs and urinary organs. The chief objection to its ufe is its difficult combination, and its afterwards lying heavy on the ftomach.

Bees-wax, and all the other kinds of wax, are chiefly ufed externally, in combination with the oils, in the form of unguents, cerates, and plafters. It is fometimes, however, formed into an emulfion, in chronic dyfentery, with fuccefs.

Lac is never employed in medicine but as a colouring fubftance, and its chief ufe is to tinge fealing-wax.

CCCXLVIII.

Amber is efteemed in medicine a powerful antifpafmodic, and is ufed in a variety of forms, as we fhall afterwards find, in a number of nervous diforders.

Ambergrife is folely employed as a perfume.

With the petrolea, external friction is recommended in rheumatic and paralytic cafes.

CCCXLIX.

On the whole, the clafs of inflammables afford a fet of remedies of powerful operation; but though agreeing in one general principle, they differ very much otherwife in their fecondary properties.

CCCL.

Class IV. *Salts.*

The next clafs of bodies, or the faline, is perhaps the moft numerous of any one, from their ftrong tendency to combination. They confift all of oxygen, fixed in combination with fome combuftible body, and water is often

present, without being an immediate part of their composition.

CCCLI.

Of this class of bodies, their solubility in water is their leading characteristic, as formerly observed (VII.); and in dissolving them certain phenomena are found to occur.

CCCLII.

These phenomena consist in

1. A separation of air; 2. A change of temperature; and 3. An increasing slowness of solution.

CCCLIII.

In regard to the first, the dissolving fluid becomes milky or muddy, and little globules of a gazeous form appear on the white surface of the liquor.

On the second, it is observed, that the temperature is sometimes diminished, and depends on particular circumstances attending the solution, as afterwards noticed.

In respect of the last, the facility of solution is always greatest at first, and gradually lessens, till it arrives at its ultimate point termed saturation; and this power is prolonged, or the quantity dissolved augmented, by two circumstances, agitation and heat. By the last of these, or an increase of temperature, a larger portion of salt can be made to dissolve, though it is apt again to separate on the fluid losing this temperature.

CCCLIV.

Salts are divided into two kinds, the simple and compound, and these possess either a solid or fluid form.

CCCLV.

The effects of heat on both kinds is very similar, producing their expansion and even conversion into vapour, and, in a low degree, their consequent condensation, &c.

CCCLXVI.

When in a solid form, their attraction for water is so great, that exposed to the air they attract it, prove it, and run into deliquium, or become deliquescent. The degree of solubility, however, they possess, or tendency to deliquesce differs in different salts; and the quantity dissolved before saturation take place, is influenced by the circumstances already recited.

CCCLVII.

The liquefaction or solution of salts, produces, as already mentioned, a change of temperature, wherein the salt is in a solid form, like that of all solid bodies, their solution produces a degree of cold; and the same also happens when the water is in a solid state, and the salt, on the contrary, the reverse. In dissolving, however, all the fluid salts the opposite of this, or a degree of heat is produced; and the same also takes place, when in consequence of their union with water the latter assumes a solid form, and likewise when the salt, being in the form of elastic vapour, is by this union condensed.

CCCLVIII.

All salts, whether possessed originally of a fluid state, or rendered so by solution, may be reduced to a solid form, and this is performed by evaporation; and according to the degree of evaporation they receive, two species of this process arise, the first termed *evaporation*

to dryneſs, when a briſk heat is applied to the fluid, and continued without interruption till it is entirely exhaled, after which the ſalt is found to conſtitute a white ſpongy maſs, the parts of which are too ſmall to diſcern their figure; and ſecond, cryſtallization, when it is performed only to a certain degree, or what is termed, to a pellicle; and the water remaining not being ſufficient to retain the ſalt diſſolved; on the mixture's cooling, the latter ſeparates in part, and clings in the form of angular maſſes, which from their tranſparency, are termed cryſtals.

CCCLIX.

It is in this laſt ſtate that ſalts have been chiefly conſidered; but it is by no means their pure ſtate, as they contain always a quantity of water combined with them; and to this they owe that quality they poſſeſs, when heated to a certain degree of decrepitation, the water contained not being ſufficient to produce on them the watery fuſion; but when converted into vapour, it eſcapes in this way, with noiſe and exploſion.

CCCLX.

Another peculiarity in the ſolution of ſalts is, that the ſame fluid, when ſaturated with one ſalt, will diſſolve another; and even afterwards diſſolve more of the firſt ſalt, the one increaſing the ſolubility of the other. The conſequence of this compound ſolution is often a ſtrong combination of the ſalts diſſolved; but in other caſes not—a ſeparation from ſuch compound ſolution may be effected in conſequence of their difference of volatility, by ſubmitting the ſolution to ſublimation, or from their difference of ſolubility, by evaporating to a certain degree,

or by expofing the dry mafs to deliquefcence, reduced to a folid ftate; or laftly, allowing them to cryftallize, when the falts will fall to cryftallize in a different form. This procefs may be repeated till complete.

CCCLXI.

Simple falts are divided into two orders, of alkalies and acids.

CCCLXII.

Alkalies are falts of a peculiar pungent tafte, are cauftic when pure, or corrode the fkin, and diffolve animal matter They change blue or red vegetable colours into green. They unite with acids, and both thereby lofe their diftinguifhing qualities. They unite alfo with oils or animal fats, to form foaps. They diffolve earths, and attract water from the atmofphere.

CCCLXIII.

Alkalies, from their origin, have been divided into three different kinds, as derived from the vegetable, foffile, and animal kingdoms

CCCLXIV.

Vegetable Alkali.

The vegetable alkali is a pungent falt procured from plants, particularly their woody parts burnt to afhes. Its appellation is derived from kali, the Ægyptian name of the plant firft ufed to procure it. It is freed from the impurities of the afhes by folution, and evaporation repeatedly taking place; and it is then prefented in a folid form, of a white colour.

CCCLXV.

In this ftate it is highly cauftic, powerfully attracts

humidity from the atmoſphere, changes vegetable blue colours to a green, and is fuſible at a moderate temperature, though it cannot be volatilized.

CCCLXVI.

One of the chief and moſt uſeful properties of this alkali is its combination with oils, in the formation of ſoap; and to render it more cauſtic for this purpoſe, it is combined with lime. Thus, if one part of the oil be mixed with half its weight of a ſtrong ſolution of pot-aſh, a thick white maſs is found diffuſible in water, forming a milky like mixture. By boiling a more intimate union of this compound is formed, and a ſolid ſubſtance procured.

CCCLXVII.

Soap.

Thus ſoap derives its ſolubility and detergency from the cauſtic alkali; and the oil is neceſſary, in order to moderate the ſharpneſs and activity of the alkali, and to give a ſlipperineſs to the clothes, otherwiſe it would injure the clothes, and it would be impoſſible to handle them with the cauſtic alkali adhering; and as one of the means of extracting the foul matter is mechanical violence, it would injure the clothes greatly, were they not rendered ſlippery, and the friction diminiſhed. So in the proceſs of bleaching, where the cloth is expoſed to violent friction, it anſwers the purpoſe.

CCCLXVIII.

Soap is alſo ſoluble in ſpirit of wine, and in a mixture of ſpirit of wine and water it is ſtill more ſo than in either ſeparately. Heat increaſes the diſſolving powers of theſe

menstrua, and cold diminishes it; if too much is dissolved by heat, the superfluity concretes into threads, or a jelly, in proportion to the quantity; but this jelly has a sort of fibrous structure, and contains in its pores a quantity of liquid matter. Soap, dissolved in spirit of wine, has a disposition to concrete into fibres, and the spirit acts upon the soap in consequence of its attraction to the oil, as well as for the alkali. For when we decompose the soap, so as to have the oil pure, it will dissolve in the ardent spirits; it has undergone some change which gives it this quality. So we can readily separate the oil from the alkali, by means of acids, which immediately unites with the alkalies.

CCCLXIX.

This effect of acids has led to the knowledge of the cause of hardness in waters, with respect to soap. The meaning of this term is, that such water renders the surface of the soap greasy, and requires the soap to be agitated long before it will form a lather with it; and when by long agitation we obtain a dissolution, the water throws up a greasy scum, consisting of the oil of a small part, decomposed by an acid in the water.

CCCLXX.

Such waters are rarely found to contain a pure or separate acid; but combined with some substance that does not adhere so strongly, as the calcarious earth, the earth of magnesia, of alum, and in the several metals in which the acid is so little feltered; yet it is ready to act as if it was pure: so it prevents the water from readily dissolving the soap, till by the foresaid dissolution of a small quantity the acid is neutralized; after

which it will diſſolve the ſoap, as well as other pure water.

CCCLXXI.

This quality of waters proves often very inconvenient, as there are many manufactures in which it is neceſſary to employ large quantities of ſoap, diſſolved in water; ſo it is of great conſequence to have water as ſoft as poſſible, to prevent a waſte of ſoap, as in bleaching, &c. And therefore it is of conſequence to learn how to diſcover hard water, and to find out a cure. Different methods have been propoſed; but there is no occaſion for many new chemical trials; the trial with ſoap is as accurate and nice a one as is neceſſary. Or dropping in a ſolution of fixed alkali, if there is any ſuch compound, it renders the water muddy; but unleſs there be a certain quantity, the muddineſs will not be obſervable, yet the water is hard with regard to the ſoap; ſo the trial with a bit of ſoap is ſufficiently nice.

CCCLXXII.

With regard to the cure, there is no doubt the addition of an alkaline ſalt will remove this bad quality; but it is plain that this remedy cannot be put in practice, at a moderate expence; and it is eligible to chuſe a water, that is naturally ſoft. This method of ſoftening water is employed on particular occaſions, as in cookery; a ſmall quantity of alkali added makes the water boil vegetable ſubſtances more quickly and more tender, and at the ſame time it preſerves their colour in greater perfection.

CCCLXXIII.

Beſides the oils, this alkali forms various combinations with the other inflammables, as we ſhall afterwards find;

but it possesses no action on the simple gases. Its strongest attraction is for water, being the most deliquescent of the three alkalies, and it dissolves in a quantity of fluid equal to its own weight; but, at the same time, by evaporation, it can be reduced to a crystallized form; and from some facts, its analysis has been referred to be a combination of lime and hydrogen, though this is by no means established.

CCCLXXIV.

Fossil Alkali.

Fossil alkali, or soda, possesses all the more general qualities of alkalies enumerated. It requires a strong heat to melt it, and evaporates when it is exposed to a strong heat. It dissolves in water without any impetuosity, and about one-sixth of its weight in water saturates it. It is easily separated by crystallization, affording crystals that are flattish, two planes uniting at their edges with two other planes, forming an oblique termination by their union; but it is difficult to get these quite perfect; most commonly one end, or the greatest part of one crystal, being entangled with another.

CCCLXXV.

These crystals contain a great deal of water, in consequence of which they are liable to the watery fusion; but when the heat is suddenly applied, so that the water quickly evaporates, the salt cements in the form of a crust. In like manner they are liable to spontaneous calcination; but when kept in dry air, a part of the water is apt to evaporate, whereby the crystal loses their transparency.

CCCLXXVI.

With regard to its origin, it is one of the ſalts which has been longeſt known and in uſe. It is mentioned under the name of nitre, in ſeveral parts of the Bible, as appears from the different qualities mentioned belonging to nitre, and which ſhew it to have been a ſort quite different from that now known by the ſame name.

CCCLXXVII.

It has alſo been got in conſiderable quantities in Africa, in the kingdom of Tripoli in Barbary, being brought from ſome of the mountains to the ſea-coaſt, as a conſiderable article of commerce. Great quantities are ſent to Conſtantinople. It is a natural production, and dug up from the bowels of the earth, by running among very large quanties of common ſalt. There are alſo mountains of it in the inland parts of Africa, and there are alſo veins found of this alkali. It is likewiſe found in Egypt, where it forms a kind of hoar-froſt upon the ſurface of particular places, and where it is left by ſtagnating water, which had it diſſolved. It is alſo found upon Teneriffe; but there are no examples of it in Europe, only upon the plaſter of walls and cellars, and other damp places. We find a white downy efflorescence, which is found chiefly to conſiſt of the foſſil alkali, which is the only example of a natural production, except what is found in the waters of ſome mineral ſprings; and we have no ſuch examples of it as found in Africa. Upon the whole, we rarely meet with it in its independent ſtate, but it occurs in combination with other ſalts, and in this ſtate it is found in immenſe quantities in the bowels of the earth, and in ſprings; alſo in the ſea, ſo as it got the name of

fossil; and such a salt is obtained from the ashes of sea plants; the one for obtaining it of the best quality, is the kali, and from this plant all the alkalies have got their name. The ashes from sea-weeds are prepared upon the coast of the Mediterranean, under the name of soda; and upon our coasts they melt the ashes into an impure mass, called kelp, which is purified by those that use it.

CCCLXXVIII.

In its pure state soda is a solid white mass; in its leading qualities it resembles the vegetable alkali, and they differ chiefly in their orders of attraction, as we shall afterwards find. From analysis, this salt has been supposed a combination of magnesia and hydrogen.

CCCLXXIX.

Volatile Alkali.

The volatile alkali, or ammonia, differs from the two former more than they do from one another. It shews a great degree of volatility when exposed to a gentle heat; in the ordinary heat of the air, affording vapours which affect the nose. It is commonly known by the name of volatile salts. So salt of hartshorn when exposed to heat, totally evaporates long before it arrives at the heat necessary for its fusion; and if a cold body is exposed in the way of its steam, it forms a solid white saline crust upon the internal surface of the body. It does not seem acrid; for when applied to the skin, the heat makes it evaporate; but when it is confined by a plaster, it will quickly destroy that part to which it is applied. It dissolves easily in water, and sometimes crystallizes; but it cannot be separated by evaporation and

cryſtallization. It is ſo volatile that when heat is applied, it begins to evaporate firſt.

CCCLXXX.

With regard to its origin, it is found no where in nature pure. Sometimes it is found in the air, hanging over animal and vegetable ſubſtances, produced by their putrefaction. By a burning and deſtructive heat applied to them, they produce vapours; and theſe vapours, when condenſed, are found to contain a large quantity of this ſalt, with other matters which repreſs its volatility. Urine, putrified to a certain degree, is found to contain a conſiderable proportion of it; and hence the detergent quality of putrid urine. No animal ſubſtance affords it in greater quantity than the horny parts and bones. Formerly the horns of the hart were, for this purpoſe, principally uſed in pharmacy, and hence the ſalt ſtill retains the name, though now the chemiſts have found that it is afforded, of the ſame quality, by other animal horns and bones; and they employ the animal bones of different kinds, out of which the oil has been previouſly extracted. There is alſo a compound ſalt, of which it conſtitutes the half, viz. ſal ammoniac; and from this it can be prepared in a purer ſtate than from any of the former ſubſtances, as thus obtained it is called ſal ammoniacum volatile. In all theſe proceſſes a quantity is commonly combined with the water, as in extracting it from animal ſubſtances by means of fire; and in the ſeparation of it from urine it would require many repeated diſtillations to ſeparate it entirely. Such a part as ariſes in a watery form has been called ſpirit by the chemiſts, which name they have given to moſt alkalies obtained by diſtillation;

hence the ſpirit of hartſhorn, of urine, of ſal ammoniac. Theſe are all names for the ſame alkali, as combined with the water, and in different ſtates of purity.

CCCLXXXI.

Thus it is obtained from animal ſubſtances either by heat or putrefaction. The compoſition of ammonia is more certainly known than that of the other alkalies; and it is diſcovered, by its decompoſition, to conſiſt of a combination of hydrogen and azote, being formed by preſenting the two gaſes to each other in their naſcent ſtate.

CCCLXXXII.

The ſolution of theſe different alkalies in water is diſtinguiſhed by different appellations, which are neceſſary to be known: the firſt, or vegetable, being named cauſtic lie; the ſecond, or foſſile, ſoap lie; and the third, or volatile, cauſtic volatile ſpirit.

CCCLXXXIII.

Acids.

Acids, the oppoſite of alkalies, are ſalts of a ſour taſte, and always appear naturally in a fluid form. They change vegetable blue colours into red, act as cauſtics on animal matter, and have a ſtrong attraction for water. With alkalies and alkaline earths, they efferveſce and form compounds, on which the diſtinguiſhing qualities of each are loſt, and a neutral ſalt formed.

CCCLXXXIV.

The acids are more numerous than the alkalies, and they are divided like them into the foſſil, vegetable, and

animal; of each of which, particularly of the fecond, there is a great variety.

CCCLXXXV.

As alkalies are a compofition of hydrogen and azote, fo acids are entirely a compofition of oxygen, with a particular bafe. This we formerly obferved on that fubject (CCXXII.); and according to the various proportion in which the oxygen is united with the bafe, the acids are diftinguifhed, as there ftated, by different terminations (CCXXV). From oxygen being fo much abforbed by the combuftion of inflammable and metallic bodies, acids are particularly formed by this procefs.

CCCLXXXVI.

The foffil acids, being the moft powerful, claim our attention firft, and they are diftinguifhed by the names of the fulphuric, nitrous, and muriatic. They are alfo diftinguifhed by certain common qualities.

CCCLXXXVII.

On account of the manner in which they are obtained, the only form we can have them in is that of a watery fluid, which is their ftrongeft ftate. In this ftate they may be confidered as volatile, when compared with the more fixed falts. The vitriolic does not endure a degree of heat that makes it red hot, and the other two are much much more volatile than it.

CCCLXXXVIII.

They all agree in having a very ftrong attraction for water; they attract it from the air very quickly, and unite with water, with rapidity, violence, and the production of heat. Upon this account it has been thought

ſtrange that they ſhould produce cold, when mixed with ice; but this has been already explained, as depending upon the great quantity of heat abſorbed by the ice, when liquified by the acid. As the nitrous acid produces the moſt intenſe cold, ſome have repreſented the vitriolic as incapable of producing cold in this way; but this ariſes from the improper way of making the experiment, their uſing too large a proportion of it for the firſt acid added, liquified the ice, and produces the cold; but after it is made liquid, by adding more acid, it will produce heat. So care muſt be taken not to add more of the acid to the ice or ſnow than is barely ſufficient. And in like manner, with the other acids, though the vitriolic cauſes the greateſt error, as it produces the greateſt heat in mixing with the water. When it is diluted with a large quantity of water, we can in ſome meaſure ſeparate it again by diſtillation; and by repeating the proceſs of diſtillation, the acid is obtained in its ſtrongeſt ſtate; and this operation is called the rectification, dephlegmation, or concentration of acids; but the operation can only be carried to a certain length; for their attraction for water is ſo ſtrong, that they cannot be had dry, therefore acids are always found, exhibited, and uſed in the form of fluids. They are to be conſidered as ſolid fluids diſſolved in water, and appearing in a fluid form, in conſequence of their combination with that fluid. This makes it difficult in them to ſhew any natural tendency to ſolidity; this tendency, however, is ſhewn on different occaſions. The vitriolic, when ſtrong, will become Glauber ſalts, a great part of it being formed into ſmall fibrous cryſtals, ſo as to give the whole the form of ice.

CCCLXXXIX.

In like manner, with regard to the nitrous acid, Farenheit, in producing a great degree of cold by the mixture of this acid with ſnow, at 40 below nought, found that ſome ſmall phials of the pure acid were coagulated, and part of the ſalt was formed into cryſtals throughout the liquor; ſo we have experience of a tendency to ſolidity in theſe two acids.

CCCXC.

With regard to the muriatic acid, no cryſtals have been obſerved to have been produced in it; but by expoſing it to the ſame or a greater degree of cold, it might diſcover alſo the tendency to ſolidity.

At any rate, there is another way of taking the acids, which ſhews that they are at bottom of the ſame nature with other ſalts, by joining them with the fixed alkalies. With theſe they unite very ſtrongly, their volatility is repreſſed, their attraction diminiſhed, and we can ſeparate the water from them by evaporation, and have them in a dry ſolid form, requiring a ſtrong red heat for fuſion, capable of being reduced to the form of cryſtals, and having all the other qualities as belonging to the ſalts in general.

CCCXCI.

Another quality in common with the acids is, that like alkalies they change the ſame infuſion, viz. the purple and blue colours of vegetable ſubſtances, but in a different manner; for if blue, they change it into a red; or if purple naturally, they brighten the red, and diminiſh or entirely aboliſh the blue. A very ſmall quantity of the acid is ſufficient to produce this change. This change of colour is ſhewn in the infuſion of roſes, the ſyrup

of violets, and in the infufion called litmus, or turnfoil, which is fold by thofe who deal in dying; and the effect produced by the three acids is exactly the fame, though the different colours of vegetables are differently affected. In fome the acid is ftronger, and the blue more fully abolifhed; and the fame effect is produced, though they have been previoufly tinged of a green colour by an alkali. In like manner, the alkali will change the colour alternately. If the alkali is added gradually to the fyrup of violets, for inftance, it firft reftores the natural blue colour; but if more is added, it changes it to a green.

CCCXCII.

Another common quality of thefe acids is, that of uniting with the alkalies, and producing an effervefcence; and it is therefore ufed as a criterion of the acid falts; for there is no other fubftance foluble in water that effervefces in the fame manner, except the acids, and this is in like manner ufed as a criterion of alkaline falts; for there is no falt foluble in water that effervefces with acids, except the alkaline falts. Thefe acids alfo effervefce with the metallic fubftances, and with the abforbent earths, as chalk, limeftone, marble, &c.; and as they fhew a peculiar diffolving power over earths and metals, they fhew an acrimony and corrofive power over animal fubftances. If taken internally, they would deftroy the places to which they are admitted; and when they are applied to the furface of the body, they produce a pain like a burning coal, and as quickly deftroy the part.

CCCXCIII.

Thefe properties they fhew in their ftrong ftate. When

diluted with water, to a certain degree, they have not these powers; they lose entirely that excessive acrimony, and their most general effect is to prevent or retard fermentation or putrefaction, and they are taken as medicines. They are cooling and astringent, and impress a particular taste upon the tongue, which their name imports.

CCCXCIV.

Sulphuric, Sulphureous, or Vitriolic Acid.

In entering upon the acids, as formerly observed, they are presented always in two states, as containing a greater or less proportion of oxygen, which states are distinguished by their different terminations of   and *ous*.

The name of this acid is derived from vitriol or copperas, from which it was formerly prepared, and in which state it is combined with iron; but is now most commonly procured from the combustion of sulphur. When pure it is colourless and transparent, of great weight, almost of double that of water; at the same time, it has somewhat the appearance of less mobility or fluidity than water; and having some degree of the sluggishness or lentor of oil, it is called oil of vitriol. The salt it contains is more fixed than water, so that it endures the heat of the air, and even a more violent heat, without our perceiving any effluvia proceeding from it, or its giving the least perceptible smell. It has such a powerful attraction for water, that the heat which is produced by their union is supposed to be occasioned by it; but perhaps it is more probably owing to the contraction of the volume which takes place, being remarkably strong in this mixture. The heat is so strong, that if the union is made in a glass vessel not fitted for bearing such sudden alterations of heat

and cold, it will be broken. The most convenient is a Florentine flask. So great is its effect, that if water is applied to the outside of the vessel, it is thrown off in steams; and if the water is warm, there is a stronger agitation or commotion of the mixture, the addition of heat communicated by the acid, converting a part of the mixture into steam, by which means it is thrown out of the vessel.

CCCXCV.

It is now employed in the process of bleaching linen; and some of the manufacturers have complained of the danger of its falling in small drops upon the linen, which eat out into small holes; but it has been found that they followed the practice of mixing it with hot water instead of cold; and by the sudden explosion and ebullition of it, small drops of it were thrown about and scattered, so as to fall upon the linen. There is no advantage in using hot water, neither is there any difficulty in mixing it with the cold, so as to give the water the pretty sharp acidity wanted. It would indeed be a long time before the equal diffusion took place, if it were not agitated, from its falling to the bottom, on account of its great weight. If once equally dispersed, it will never separate again.

CCCXCVI.

The attraction of this acid for water appears from the quickness and readiness with which it unites it from the air, any quantity exposed to the air, attracting one-third of its weight in a day; and when long exposed, it will attract five times its weight, which is about 12 times its bulk. But the quantity attracted every day becomes less and less, having the greater attraction for water, the less it contains already, as is the case with the other salts.

CCCXCVII.

In rectifying this acid, it is neceſſary to manage the operation in cloſe veſſels, though it is more fixed than the water, otherwiſe a great part of the acid will be loſt. The retort and receiver are therefore uſed. The firſt vapour is nearly a pure water, and does not require much more heat than boiling water; but the remainder is much more ſtrongly retained by the acid, and a more violent heat is required to continue the diſtillation. At length the heat riſes to 600 of Farenheit, when the vapour ariſing contains as much acid as the liquor that remains in the retort, and then it is needleſs to continue the operation any longer. This operation is performed to prepare it for the market. For reducing it to a certain ſpecific gravity, the watery part that comes firſt over, is put into the retort again, and the diſtillation repeated, whereby the acid is all recovered.

CCCXCVIII.

This acid is moſt remarkable for its action upon the inflammable ſubſtances, in conſequence of the attraction of the latter for its oxygen; thus, if a little of it be put into a glaſs, and ſome olive oil poured thereupon, the colour is generally darkened, a ſenſible degree of heat is produced, and ſometimes ſteams ariſe from the mixture. The oil becomes very thick by the action of the acid, conſtituting a compound that has very near the conſiſtence of tar, and is of a colour that reſembles it, being at the ſame time very pungent. Suffocating vapours are emitted from it; but the oil that is uſed is not one of thoſe that contains the principle of inflammability, in its moſt looſe and ſeparate ſtate.

CCCXCIX.

If one of that kind is taken, as the oil of turpentine, the action of the acid is violent, this oil being more inflammable than the other, and containing the principle of inflammability in a more loose state. There is generally a very violent heat produced, a part of the acid and oil are suddenly changed into vapour, which burst out of the vial, the mixture is of a black colour and considerable thickness, and the oil has acquired a particular smell, different from what it has in its natural state. This acid gives the same colour to all bodies, tinging even all bodies of a black colour. So when it is kept in a negligent manner, and any animal or vegetable substance touched with it, it acquires that colour; but this colour is easily removed by boiling, its own activity and acrimony, destroying the small quantity of matter that is mixed with it.

The proportion of the sulphuric acid, is 3.68 of oxygen, and 63.2 of sulphur.

CCCC.

Nitric Acid.

Next to the sulphuric or vitriolic is the nitric and nitrous acid. This acid, when strong, is of an orange or yellow colour, and is constantly disposed to emit fumes, which is its proper form; its fluid appearance depending on its combination with a certain quantity of water. It is more volatile than the vitriolic, and of course we are less capable of concentrating it. It possesses, like the vitriolic, a strong tendency to unite with the inflammable principle of bodies, and in uniting with them it does it with violence and rapidity.

CCCCI.

The origin of this acid is rather obscure, and it is only presented to us in those situations where the process of putrefaction takes place, though the manner in which it is here produced we cannot account for. At present it is extracted in greatest quantity from the compound salt, saltpetre, by adding to it a certain quantity of diluted vitriolic acid, and distilling them, when the nitrous acid rises in the form of elastic vapour; mixed with the vitriolic, and by adding to it a fresh quantity of nitre, and resuming the distillation, the nitrous acid is obtained pure; and by farther exposure to heat, from the nitrous it is converted into the nitric.

CCCCII.

In combining with water this acid produces heat; poured on snow or ice it melts, and produces intense cold. Its composition is a combination of oxygen and azote, and its proportions are 72.2 of oxygen to 72.8 of azote in the nitric, and in the nitrous 70.1 of oxygen to 29..9 of azote.

CCCCIII.

Muriatic Acid.

The last of the fossil acids is the muriatic, which possesses a pale colour, and in its pure state emits fumes like the nitrous, though these have no effect in tinging the glass, and its odour is equally corrosive with the former. It differs from the two other acids in having little attraction for the principle of inflammability, and on mixing with water, it loses entirely its caustic state.

CCCCIV.

This acid is found, in small quantity, diffused in the atmosphere; but its most common source is from ...

with which it is combined, and from which it is obtained, by mixing it with the oil of vitriol, and submitting them to distillation.

CCCCV.

The composition of this acid has been supposed a combination of hydrogen, azote, and oxygen, but it is not confirmed by decisive experiments.

CCCCVI.

Oxygenated Muriatic Acid.

As the muriatic acid is capable of combining with oxygen, a compound is formed, by which its acid powers are lessened, termed the oxygenated muriatic acid. This acid peculiarly whitens vegetable colours, and differs in its attractions from the others. It is procured from the distillation of the black oxyd of manganese with the acid.

CCCCVII.

These acids, in their diluted state, have received different appellations; the first, or vitriolic, being named oil of vitriol; the second, or nitrous, aquafortis; and the third, or muriatic, spirit of salt.

CCCCVIII.

The fossil acids differ from all the others in their activity, and are always procured in the purest state; and by this they are distinguished from the rest, though they agree in their more general properties.

CCCCIX.

Boracic Acid.

The boracic is an undecomposed acid. It does not exist in great quantity. It is chiefly found in combination with soda, and from this salt it is obtained, by adding to

its ſolution a proportion of ſulphuric acid, till it acquires an acid taſte. On cooling, white ſcales are depoſited, which are freed, by waſhing, from any ſulphuric acid, and are again cryſtallized. It is likewiſe procured by ſublimation.

CCCCX.

This acid is in the form of white ſcales, ſoft and ſomewhat unctuous to the touch. It poſſeſſes a ſaline cool taſte, ſomewhat bitteriſh, with a ſlight degree of ſourneſs. It reddens the vegetable blue colours, is ſoluble in twenty parts of cold, and five of boiling water. It is diſſolved eaſily in alcohol, the ſolution being of a beautiful green, and burning with a green flame. By its fixity in fire, it is greatly diſtinguiſhed from the other mineral acids.

CCCCXI.

Fluoric Acid.

This acid is alſo one of thoſe poſſeſſing an undecompoſed baſe, and is procured from the foſſil named fluor ſpar. It is obtained by adding one part of ſulphuric acid to an equal weight of coarſely powdered fluoric ſpar, and then applying a moderate heat. The acid comes over in the form of gas, as formerly noticed, and is abſorbed by water, in which ſtate it retains the acid properties. Its diſtinguiſhing quality is its power of diſſolving ſiliceous earth, which reſiſts the action of every other acid. This earth it diſſolves very rapidly, and holds in a ſtate of combination. In ſmell and taſte, it reſembles the muriatic acid.

CCCCXII.

After the foſſile, we enter upon the vegetable acids, of which modern chemiſtry has greatly increaſed the number, by our improved knowledge of the acidifiable

bases, from our greater powers of decomposition. This basis, in all the vegetable acids, is of a compound nature, being a proportion of carbon and hydrogen. The varieties in their properties depend on the different proportions of these principles, and of oxygen in each of them. These acids admit a division into three kinds, as ready formed, as obtained by the use of the nitric acid, or by the action of fire.

CCCCXIII.

Citric Acid.

Of the first division, the citric acid is a principal one. It is found particularly in the lemon, the tamarind, and several other sour fruits, being obtained by expression. It is freed from its mucilaginous matter in several ways, as first, by precipitating it by alcohol; or secondly, by squeezing the juice of lemons, while the acid remains liquid, and in a concentrated state; or thirdly, by straining the juice through a linen cloth, then mixing it with spirit of wine; and after standing some days, it may be filtered through paper, when it will be found pure. Or what is a more common practice, by saturating the juice with powdered chalk, than separating the chalk by the addition of half its weight of sulphuric acid to the compound, diluted with six pints of water, when by evaporation of the filtered solution, the pure acid will be obtained.

CCCCXIV.

Citric acid is decomposed by heat, and its products are carbonated hydrogen, carbonic acid, and an empyreumatic acid, with charcoal. When farther oxygenated, it is convertible into two acids, the carbonic and acetic.

CCCCXV.

Malic Acid

Malic acid, the next in order, is chiefly procured from unripe apples. It is obtained pure by saturating the juice with chalk, and decomposing the compound by sulphuric acid, when the filtered solution is to be evaporated to a certain degree, for no crystals are formed.

CCCCXVI.

It is decomposed, like the former, by heat, and yields more of the carbonic acid. It is likewise convertible by the nitric into the oxalic acid.

CCCCXVII.

Oxalic Acid.

Oxalic acid, the third species, is chiefly found in the different kinds of sorrel. The exprest juice, freed from impurities, deposits the acidulous oxalate of potash; and when freed from the latter, the acid has a penetrating sour taste, effervesces in the air, is soluble in half its weight of hot water, and twice its weight of cold.

CCCCXVIII.

This acid, exposed to heat, is resolved into an acid liquor, carbonic acid, and carbonated hydrogen. It contains more oxygen than the other vegetable acids.

CCCCXIX.

Tartarous Acid.

Tartarous acid, as it exists in vegetables, is combined with potash; and under the name of tartar, is contained in the tamarind, vine, and other fruits, being chiefly deposited during the slow fermentation of wine in casks. It is purified by solution, filtration, and repeated crystal-

lization. It has a sour taste, and requires for its solution 60 parts of cold, and 30 of boiling water. By exposure to heat, it becomes decomposed. Its pure acid is procured by the addition of sulphuric acid to the solution of the salt. Its products, by exposure to a high temperature, are carbonated hydrogen and carbonic acid, an acid similar to the acetous, and an empyreumatic oil, charcoal remaining.

CCCCXX.

Benzoic Acid.

This acid exists chiefly in the balsams, and more particularly in benzoin, being extracted from it by the application of a moderate heat. The acid volatized, condenses in white crystals. This acid exists also in the urine of graminivorous animals. But it is more commonly procured by boiling four parts of benzoin, with one of lime, and four of water, stirring them together over a gentle fire, for half an hour, by which the acid uniting with the lime, benzoate of lime is formed. After settling, the clear liquor is poured off, and the process twice repeated, with fresh lime water. The liquor should be then filtered, and muriatic acid added, as long as any precipitate, which is the acid of benzoin, falls. It is then to be dissolved, filtered, and gently evaporated. It is procured by sublimation, in the form of flowers of benzoin. It possesses a slight pungent taste and grateful odour; in which it differs from the other acids by retaining an essential oil. It is chiefly soluble in hot water, and the solution crystallizes in cooling. It is soluble also in alcohol, and is volatilized by a moderate heat. It burns when strongly heated in contact with air. It possesses a strong attraction for lime.

CCCCXXI.

Gallic Acid.

This acid is yielded by many barks, roots, and fruits, and is in all thofe vegetables termed aftringent; but it is moft commonly obtained by an infufion of powdered nut-galls, in the proportion of one lib. of powder, to two pints three quarters of water. This infufion, after ftanding four days, and frequently fhaking the mixture, is then filtered, and kept in a veffel covered with blotting paper. A thick pellicle of mouldinefs then forms on the liquor, and a precipitate defcends in proportion as the infufion evaporates. This precipitate, diffolved in water, forms a liquor of a brown yellow colour, which in evaporation depofits the acid in a precipitate, like fine fand, and cryftals of a yellow hue.

CCCCXXII.

This acid has a four, aftringent tafte, effervefcing with chalk, and reddening turnfole. It is foluble in three parts of hot or 12 parts of cold water. By heat it becomes volatilized, and partly decompofed; from which it appears to confift of an empyreumatic oil, carbonated hydrogen, and carbonic acid. Hydrogen and carbon, therefore, form its bafe.

CCCCXXIII.

The peculiar diftinction of this acid is that of producing a deep black colour with the falts of iron, when the metal is in a certain degree of oxydation; but it is only the red oxyd that fucceeds in the making of ink. Thus the combination of iron with the gallic acid is the bafis of ink and black dyes.

CCCCXXIV.

Tannin

Connected with the gallic acid, is the tannin or tanning principle. Their properties are however different, and they can be obtained distinct, though they exist always in the same substances. To obtain this principle in the pure state, to an infusion of oak bark in hot water, a solution of muriat of tin is added. Thus an insoluble compound of tannin with oxyd of tin is formed. If a current of sulphurated hydrogen is passed through the liquor, it combines with the oxyd of tin, and the tannin is left dissolved. This solution is of a brown colour, and has a bitter styptic taste, and by evaporation it may be obtained in a solid mass.

CCCCXXV.

It communicates to iron the same dark colour as the gallic acid, but its peculiar property is to combine with animal gelatine, on which the art of tanning depends, and to prevent the decay of those parts with which it is combined.

CCCCXXVI.

Camphoric Acid.

The next division of vegetable acids is those obtained by the mediation of the nitric acid The first of this division is the camphoric acid, which is obtained by the decomposition of camphor. When pure it has little or no odour; its taste is slightly acid, and it reddens the vegetable colours. It is very volatile. It is distinguished from the benzoic acid, which it much resembles by its greater solubility in cold water. It burns without any residuum.

CCCCXXVII.

Suberic Acid.

The ſuberic acid is obtained, as its name imports, by diſtilling nitric acid from cork. The reſiduum is expoſed to a moderate heat, till pungent, ſuffocating vapours ariſe. To this thrice its weight of water is added, and heat applied. The ſolution of ſuberic acid then obtained, is ſeparated by filtration, when cold. It may be alſo obtained by evaporation, in a ſolid form. It is volatilized by heat, is ſoluble in water, poſſeſſes an acid bitteriſh taſte, and becomes brown by expoſure to ſolar light. It differs from the former acid both in its precipitation and form.

CCCCXXVIII.

Succinic Acid.

The ſuccinic acid is obtained by expoſing amber to a moderate heat, an empyreumatic oil, with an acid liquor, diſtils over, and a matter concretes in cryſtalline plates, in the neck of the retort. This matter is the ſuccinic acid, which may be purified by a ſecond ſublimation, or by ſolution and cryſtallization. It is likewiſe procured by diſtilling weak nitric acid with half its weight of ſalt of amber, the nitrous gas coming over, and leaving the acid behind.

CCCCXXIX.

The taſte of this acid is acrid; it is ſoluble in 24 parts of cold and in two of boiling water, the latter cryſtallizing on cooling. Its cryſtals are permanent in the air, and are volatilized by heat.

CCCCXXX.

The third diviſion of vegetable acids are thoſe obtained by the action of fire; of theſe are,

1. The pyro tartarite acid, yielded by the tartarous acid by dry diſtillation.

2. The pyro mucilaginous acid, obtained from inſipid, ſaccharine, gummy, or farinaceous mucilages; and this acid has a peculiar property of reddening the ſkin.

3. The acetic and acetous acid, or vinegar, is produced chiefly, as we ſhall afterwards find, by the proceſs of fermentation. It is clear and nearly limpid; it has a pleaſant pungent ſmell, and a ſour taſte.

CCCCXXXI.

The acetous acid, or vinegar, is like the other acids a watery fluid, and unavoidably diluted with a large quantity of water. In point of ſtrength, it is hardly equal to a mixture of the foſſil acids, with above 50 times their weight of water. There is mixed with it ſome ſlimy and mucilaginous matter, and alſo ſome of the tartarous acid, from the wine. This acid may be purified by diſtillation, the pure acid being more volatile, and riſing in a heat little more than that of boiling water. This is accordingly often performed, and the product is called diſtilled vinegar, which turns out limpid and colourleſs, like water; the unctuous and mucilaginous matter, when the operation is carried to a certain degree, is found in the retort, forming a black matter; which, if the operation is carried farther, affords other matters that give a diſagreeable odour to all the ſteams that ariſe. It is neceſſary only to diſtil this acid, which makes it reſemble the foſſil acids, and fits it for the common uſes to which it is applied in pharmacy. It has the ſame ſour taſte with them, when they are diluted to a certain degree. It effervesces too with the alkaline ſalts, in the ſame

manner. It alſo affects the colour of vegetables in the ſame manner; thus the infuſion of roſes has its colour brightened, but the change is not ſo quick and remarkable as when the foſſil acids are uſed; neither is it equal in its corroſive qualities, even when of the ſame degree of ſtrength. Another remarkable particular by which it differs, is in its being totally changed and deſtroyed by heat, when it is ſo ſtrong as to make bodies red hot.

The acetic, or radical vinegar, is procured by ſaturating the vinegar with a metallic oxyd, and again decompoſing the compound by heat.

CCCCXXXII.

The animal acids, the third diviſion, are not ſo numerous as the vegetable, and the firſt we ſhall notice are thoſe exiſting in, or derived from the human body, as the lactic, ſebacic, zoonic, uric, and phoſphoric acids; the others are peculiar to certain animals.

CCCCXXXIII.

The lactic acid is obtained by ſubjecting milk to the acetous fermentation; but this fermentation differs from that of vegetables, both in the manner in which it takes place, and alſo in the production of the operation, being a different acid. To procure this acid pure, the ſour milk ſhould be evaporated to $\frac{1}{8}$, the extraneous or cheeſy matter ſeparated by filter, and lime water poured on the reſidue. By this a precipitation takes place, and the lime combines with the acid. To decompoſe it oxalic acid next is to be added, which precipitating the lime, leaves the acid diſengaged. This liquid muſt then be evaporated to the conſiſtence of honey; and if alcohol is added the acid will be taken up, and all the other principles

remain undiſſolved. On filtering the maſs, the pure acid will be procured by diſtillation.

CCCCXXXIV.

From the ſugar of milk is obtained alſo the ſacho lactic acid, when heated with nitric acid, with the aſſiſtance of a moderate heat.

The baſe of theſe acids is conſidered to be a compound of hydrogen, carbon, and azote.

CCCCXXXV.

Sebacic Acid.

This acid is procured from the fat of animals by diſtillation. When pure it is fluid and colourleſs, has a pungent odour, and a ſharp acid taſte. It is ſoluble in water, in all proportions, and is naturally formed in the fat, when expoſed to the air, by its abſorption of oxygen. It is decompoſed by heat, carbonic acid being diſengaged, and charcoal remaining.

CCCCXXXVI.

Zoonic Acid.

The fluid obtained from the diſtillation of animal ſubſtances has been found to contain a peculiar acid. In order to procure it the oil is firſt ſeparated from the liquor afforded, by diſtructive diſtillation; then lime added, to ſeparate the carbonate of ammoniac with a boiling heat; and afterwards more lime is added, to obtain the zoonate of lime. By diſtilling a mixture of phoſphoric acid with this preparation, the pure zoonic acid is procured.

CCCCXXXVII.

This acid has the ſmell of roaſt meat, in which proceſs

it is formed. It is of an auſtere taſte, and ſhews the teſts of an acid with turnſole.

CCCCXXXVIII.

Uric Acid.

This concrete acid of calculi is ſlightly ſoluble in boiling water. It forms the chief part of the red coloured precipitate which urine depoſits. It is therefore to be found in all urine, but only by its undue retention, or circumſtances occaſioning its formation in exceſs, does it become the ſource of diſeaſe.

CCCCXXXIX.

From a variety of experiments, it appears that the baſe of this acid is a peculiar animal oxide, and that its preſence is confined to the human body; that the ſame baſe is conſpicuous in the concretions of the gout, being formed of this acid and ſoda.

CCCCXL.

In the examination of different calculi, a great variety is found to prevail in the proportion, and even in the nature of their conſtituent principles; but this peculiar ſubſtance or baſe is always preſent in a certain degree in all of them.

CCCCXLI.

By different trials it appears, that the calculus is diſſolved by the ſulphuric acid with heat, is not acted on by the muriatic acid, is diſſolved by the nitric acid with efferveſcence, and the diſengagement of the nitrous gas and carbonic acid, the ſolution being of a red colour, and containing a diſengaged acid. Next, the calculus is not

acted on by the carbonate of potash, but is dissolved by the caustic as well as the volatile alkali. It is also dissolved in lime water, and may be precipitated by acids.

CCCCXLII.

The uric acid is insoluble in cold water. It weakly reddens turnsole; it is insipid and inodorous. When pure it has a fawn colour, and by the addition of nitric acid it acquires a pink.

CCCCXLIII.

Phosphoric Acid.

The phosphoric acid is obtained by the combination of oxygen with the phosphorus, during combustion. It is very deliquescent, and soluble in water. Its saturated solution is of an oily consistence. It is inodorous, and possesses no volatility, neither is it decomposed by heat. It consists of 100 parts of phosphorus united to 154 of oxygen.

CCCCXLIV.

These form the principal acids that are met with in the human body; those that are met with in other animals are chiefly the bombic and formic.

CCCCXLV.

Bombic Acid.

This acid is derived from the silk worm, and is contained in a cell near the anus. It is in a liquid form, and of an amber yellow colour. It is liable to spontaneous decomposition. It is obtained by squeezing the juice of the chrysalis through a cloth, precipitating the mucilage with alcohol, and also by infusing the chrysalis in alcohol.

CCCCXLVI.

Formic Acid.

This acid exifts in the ant, in a very difengaged ftate. It is evolved in a ftrongly odorate vapour, and its fmell refembles that of mufk. It is procured chiefly from the large red ant, and is moft abundant in the months of June and July, fo that the paffage of the animal over blue paper detects at once its prefence, by reddening it. The acid may be procured by diftillation, mixed with empyreumatic oil, from which it may be feparated by a funnel; or it may be procured by lixiviation, firft wafhing the animal in cold and then in boiling water, till all the acid is extracted.

CCCCXLVII.

Pruffic Acid.

The only remaining animal acid is the pruffic, obtained by expofing horns, hoofs, or dried blood, with an equal quantity of fixed alkali, to a red heat. The alkali united with the acid thus formed, is called pruffiate of potafh, or foda. The pruffic acid is obtained in a pure ftate by fuper-faturating the pruffiate alkali with fulphuric acid, and by fubfequent diftillation. It may be alfo obtained by diftilation of blood with nitric acid. It has a four tafte and fuffocating fmell.

CCCCXLVIII.

We have thus examined, in a general way, the feveral fpecies of fimple faline bodies, under the two divifions of alkalies and acids. We fhall next confider their particular action on one fubftance of the inflammable clafs, alcohol, as giving origin to fome powerful preparations

in medicine. The vegetable alkali acts on ſpirit of wine, by attracting water from it. If much alkali be uſed, a ſmall part of it diſſolves, and gives it a yellow colour and diſagreeable taſte; and if the ſpirit is allowed to retain the alkali, it is found to be a more powerful ſolvent. So the chemiſts have ſtudied the way of making tartariſed ſpirit of wine, and Dr. Boerhaave conſiders the making of it right, as a nice and difficult operation. We firſt uſe a ſpirit as ſtrong as poſſible, and we are to have the ſalt of tartar well calcined, and put in perfectly dry and hot; for if either the ſpirit has water, or the ſalts get water from the air, it will not ſucceed. But a perfect cauſtic alkali diſſolves perfectly and uniformly, and that in the ſtrongeſt ſpirit, and ſoon after it is diſſolved it communicates to it a very deep yellow or red colour, eſpecially if it is digeſted a little.

CCCCXLIX.

This explains the nature of tartariſed ſpirit of wine, and points out a proceſs by which it can be very eaſily prepared. That prepared by Boerhaave is only a ſpirit which has diſſolved the moſt cauſtic part of the common fixed alkali. But taking the alkali entirely cauſtic, we can diſſolve almoſt as much as we pleaſe; and this acting upon the oil, gives it this deep colour, which is a proof of the richneſs of the alkaliſed ſpirit.

CCCCL.

As the effects produced by an alkali that is perfectly cauſtic, upon ſpirit of wine, are different from that produced by the alkali, in its ordinary ſtate of cauſticity, ſo if we take one ſaturated with air, it is ſo much neu-

tralized by the air that it has much lefs attraction for water, and we find that the fpirit of wine is capable of feparating it.

CCCCLI.

The relation of the volatile alkali to fpirit of wine is fomewhat fimilar to that of the fixed, in its milder ftate, it will not mix with the fpirit of wine, but is precipitated. But the experiment with the volatile alkali, moft taken notice of, is the fudden precipitation of this falt from water, by means of fpirit of wine, forming the offa helmontii. Boerhaave defcribes it as difficult to be executed, on account of the great ftrength of the fpirit that was neceffary. To a quantity of the fpirit of fal ammoniac we add an equal bulk of ftrong fpirit of wine; it is poured in flowly, to float on the furface of the alkaline fpirit, and they will remain perfectly fluid. But if they are fuddenly fhaken, the mixture becomes muddy, and in fome cafes perfectly folid. This Boerhaave admires, as an example of the production of a very fubtile foap. He was an admirer of all faponaceous mixtures, and thought that this was one of the moft curious of any, and one of the moft fubtile and penetrating of any of the mixtures, as containing the moft fubtile fluid of the inflammable fubftances, combined with the moft volatile and fubtile of the alkalies; but it has only the appearance of folidity. By the moft copious and fudden precipitation of the volatile alkali, the fpirit of wine uniting with the water, difpofes the alkali to feparate in cryftallizations, which are very fmall, and the fluid that remains is entangled in the pores, as water in a fponge, the fpirit does at the fame time unite with the cauftic part, but it can

be united more perfectly with the caustic volatile alkali, merely by mixing them together.

CCCCLII.

The action of alcohol on acids is peculiar and important. The alcohol becomes decomposed, and a new compound is formed. This differs somewhat in its properties, according to the particular acid used; but all the new compounds thus formed agree in the possession of certain general qualities. They are highly volatile, odorous, pungent, and inflammable, miscible in water, and capable of combining with alcohol. These compounds are known by the name of ethers.

CCCCLIII.

Sulphuric Ether.

To prepare sulphuric ether, any quantity of sulphuric acid is poured upon an equal quantity of alcohol in a retort. They are to be mixed together by gradual agitation, after which heat is applied by a sand bath, and the retort is connected with a range of receivers kept cool by water. On the boiling of the liquor, which takes place at 208, a colourless fluid condenses in the receivers. As soon as the neck of the retort becomes obscured with white fumes, which is generally when the distillation amounts to one half of the liquor employed, the process should be stopped, and in the retort there will be found remaining a thick black fluid. The distilled liquor is to be then purified with a small proportion of potash, and subjected to distillation, when it is obtained by the second operation nearly pure.

CCCCLIV.

The theory of the formation of ether is still undecided.

It appears however that the acid refigns its oxygen to the alcohol; that part of the hydrogen of the alcohol is fpent in the formation of water, and a large portion of carbon is depofited, while the remaining principles combine to form the ether. Hence the compound differs chiefly from alcohol, in its greater proportion of hydrogen; and hence from its combuftion more water is produced than from alcohol.

CCCCLV.

Towards the termination of the procefs for ether, an oily matter comes over, which is named fweet oil of wine. This differs from the ether itfelf, in containing a larger proportion of carbon, and is confequently heavier and lefs volatile than the ether.

CCCCLVI.

Such is the procefs for the fulphuric ether, and the other ethers differ from it in fome circumftances.

CCCCLVII.

Nitric Ether.

The nitric ether is a preparation much more difficult than the former, from the violent action of the acid on the alcohol, when they are mixed together in due proportion. The acid is therefore to be cautioufly added, and in fmall quantities at a time, till an equal proportion is united. In the procefs, the nitric either partly diftils over, and partly remains in the retort, on the furface of the remaining acid liquor. It is to be poured off, and purified by a fecond diftillation, with a gentle heat.

CCCCLVIII.

In the common preparation of the dulcified fpirit of

nitre, the proportion of acid to obtain it is one part to three of alcohol, which are allowed to digeſt in a gentle heat. Thus ether is alcohol with nitric acid, partly in an uncombined ſtate; and to remove this, a ſecond diſtillation, with a ſmall quantity of alkali, will be ſufficient.

CCCCLIX.

The theory of nitric ether is ſtill more obſcure than that of the ſulphuric. It appears that part of the carbon, hydrogen, and oxygen, enters into new combinations, and compoſe the acetous and oxalic acids, which are formed, and that the remainder of theſe principles combine with part of the acid to form the ether.

CCCCLX.

No ether is formed with the muriatic acid and alcohol, but it takes place with the oxygenated acid. Acetous and phoſphoric ether can likewiſe be obtained by diſtilling theſe acids with alcohol; and adding oxyd of manganeſe to furniſh oxygen.

CCCCLXI.

Compound Salts.

We have thus deſcribed what are termed the ſimple ſalts, conſiſting of the alkalies and acids; we are now to view them in combination, under the title of compound ſalts, when they loſe the peculiar properties they poſſeſſed in their more ſimple and ſeparate ſtate.

CCCCLXII.

Every compound ſalt is formed of an alkali and an acid, either united ſpontaneouſly, as they are found at times in nature, or combined by art; and from the different kinds and ſpecies of alkalies and acids employed, the

different compound ſalts ariſe, commonly termed neutral ſalts, and the criterion in forming each of them, or of its having acquired this neutral ſtate, is not to be taken from the ceaſing of its efferveſcence, but from its effect in changing the vegetable colours, mentioned in the definition of the ſimple ones, and when it can be depended on from the taſte.

CCCCLXIII.

In forming this combination, the two ingredients can only be mixed in a certain ſteady proportion; and any addition beyond this, is not united, but remains in the ſame ſtate as before it was added. The amount of this proportion in which they can be added, is termed the point of ſaturation, and the ſalt brought to this ſtate is a neutral.

CCCCLXIV.

A neutral ſalt, compared with its original ingredients, is to be conſidered as a mild ſubſtance; it ſhews much leſs activity and acrimony with regard to a variety of ſubſtances; it has leſs attraction for water; it is not deliquieſcent; it may be taken internally, in a conſiderable quantity; and it has no peculiar effect on vegetable colours.

CCCCLXV.

In deſignating neutral ſalts, the ſtate of their acid in entering into combination, claims particular notice. When completely ſaturated with oxygen, they receive the termination of *ate*. When the acid is only in limited proportion, they are marked by the termination of *ite*.

CCCCLXVI.

In arranging neutral ſalts, we are directed by the order

in which the acids were detailed. The compounds with the fossil acids come first, beginning with those formed by the sulphuric, termed sulphates.

CCCCLXVII.

Sulphates.

Sulphat of potash possesses a bitter penetrating taste, and is soluble in 16 parts of cold water; 100 grains of it containing 40 of acid, more than 52 of alkali, and eight of water.

Acidulous sulphat of potash is the same salt supersaturated with its own acid. It has a sour taste, reddens the vegetable colours, and is more soluble in water than the neutral salts.

Sulphat of soda has a very bitter taste, is soluble in its own weight of boiling water, and in three parts of cold; 100 grains of it contain 27 of acid, 15 of alkali, and eight of water. It is found in various mineral waters.

Acidulous sulphat of soda is formed when the former preparation is saturated with its own acid.

Sulphat of ammoniac is obtained from the soot of wood or coal. It is found also in the neighbourhood of volcanoes, and it may be prepared by the direct combination of its principles. In its taste it is very bitter. In 100 grains it contains 42 of acid, 40 of alkali, and 18 of water. It is soluble in twice its weight of water, in a mean temperature, and in an equal weight of boiling water.

CCCCLXVIII.

As the salts formed by the sulphuric acid are termed sulphates, so these formed with the same acid in a different state, or the sulphureous, are termed sulphites. Their

taste is sulphureous; they are decomposed by the greater number of acids; and by exposure to the air, or to substances affording them oxygen, they are changed into neutrals of the former class—Thus:

The sulphite of potash differs from the sulphate, in its proportions being more soluble in water:

The sulphite of soda contains 18.8 parts of soda, 31.2 of acid, and 50 of water; and

The sulphite of ammonia contains 29 of ammonia, 60 of acid, and 11 of water. From these proportions their difference from the former class is apparent.

CCCCLXIX.

Sulphurets.

Besides those neutral salts formed with the acid, it is proper to notice here the compounds which sulphur forms with the alkali, termed sulphurets.

The first of these is the sulphuret of potash, obtained by fusing equal parts of sulphur and potash. It is of a red colour and inodorous, while in a solid state; but it soon imbibes moisture from the atmosphere, when it emits an odour resembling that of putrid eggs. The same effect follows its solution in water. By exposure to the air it loses its colour; and when the solution is examined, it is changed into sulphat of potash. This depends on the absorption of the oxygen of the air by the hydrogen of the solution, and the consequent oxygenation of the sulphur.

CCCCLXX.

From this circumstance it has been employed as a eudiometer, but is inconvenient, as we formerly observed, from the slowness of its operation. To obviate which,

and render the abſorption of oxygen more rapid, the uſe of the ſolid ſulphuret, ſlightly moiſtened, with the application of heat, has been preferred.

This ſulphuret is decompoſed by acids, and the ſulphur precipitating in the ſolution makes it to be termed, from its appearance, lac ſulphuris.

CCCCLXXI.

Sulphuret of ſoda differs in nothing from the ſulphuret of potaſh.

Sulphuret of ammoniac is obtained in the form of a yellow fuming liquor, by the ammoniac and ſulphur uniting in the ſtate of gas during diſtillation, from one part of ſulphur, two of ammoniac, and ſix of quicklime. It may be abſorbed by water placed in the receivers. A red coloured liquor is thus formed, which has a fœtid ſmell, and emits copious fumes. It is decompoſed in the ſame manner as the other ſulphurets; but there is danger if the ſulphuric acid is employed.

CCCCLXXII.

Nitrates.

Theſe are a claſs of neutral ſalts, formed by the combination of nitric acid with certain alkaline baſes. The attraction of the acid to theſe alkalies is ſtrongeſt to potaſh, and leaſt to ammonia. This claſs is diſtinguiſhed chiefly by its cool penetrating taſte, and by affording oxygen, on expoſure to heat.

CCCCLXXIII.

The firſt, nitrate of potaſh or ſaltpetre, is a ſubſtance well known. It is produced by nature in abundance in warm climates, while in cold its formation is aſſiſted by

art. Corrupted animal or vegetable matter, mixed with carbonate of lime, and expofed to the air, but protected from rain, after fome months afford the compound falts, which confift of nitric acid, with potafh and with lime. To their folution an addition of potafh decompefes the lime, and the nitrat of potafh is obtained, which requires to be afterwards purified.

CCCCLXXIV.

Nitrat of potafh yields a pungent tafte, and impreffes the fenfation of coldnefs on the tongue. It is foluble in feven parts of cold, and in one of hot, water. Its proportions are, in 100 grains, 44 parts of nitric acid, 51.8 of potafh, and 4.2 of water.

CCCCLXXV.

The diftinguifhing property of this body is its deflagration or vivid combuftion with inflammable fubftances, by yielding its oxygen; and on this quality of it the formation of gunpowder depends. This preparation is a compofition of nitrat of potafh, charcoal, and fulphur. Into this mixture the introduction of an ignited particle excites a vivid combuftion, rapidly propagated through the whole mafs, by which large quantities of the azotic, carbonic, and fulphureous gafes, with water, are extricated; and in confequence of their high temperature, poffefs much elafticity and expanfile force. The proportions of this compofition in gunpowder, are 75 parts of nitre, 16 of charcoal, and 10 of fulphur; and by the laft ingredient it is rendered more readily ignited. A ftill more powerful preparation than gunpowder is the pulvis fulminaris, confifting of nitrat of potafh, carbonate of potafh, and fulphur. By the mere application of heat

it detonates with violence, in consequence of the rapid production of sulphurated hydrogen.

CCCCLXXVI.

Nitrat of soda is formed artificially, by the combination of its principles. It has a cool, bitter taste. It slightly attracts the humidity of the atmosphere, is soluble in three parts of cold water, and but little more soluble in hot. 100 grains of it contain 28.80 of acid, 50.09 of alkali, and 21.11 of water. In its general properties it resembles nitrat of potash.

CCCCLXXVII.

Nitrat of ammonia is like the former, a preparation of art. It possesses like it a cool, bitter taste, is soluble in two parts of cold, and in half its weight of boiling, water. 100 grains of it contain 57 parts of acid, 23 of ammonia, and 20 of water. This salt is slightly deliquescent, and undergoes by heat the watery fusion.

CCCCLXXVIII.

The salts formed with the nitrous acid are termed nitrites, in the same manner as already explained in detail of the sulphuric acid.

CCCCLXXIX.

Muriates.

Muriates, or the combinations of the muriatic acid with alkalies, have in general a sharp taste. They suffer a decomposition from the sulphuric and nitric acids; but they are not decomposed by heat.

CCCCLXXX.

Muriat of potash has a bitter, salt taste, is soluble in three parts of cold, and two of boiling, water. Its pro-

portions confift of 46 parts of alkali, 36 of acid, and 18 of water.

CCCCLXXXI.

Muriat of foda is the moft abundant falt in nature. To it the water of the ocean owes its faltnefs; and it is found in three different ftates; in the ocean, in fprings, and in rocks, or in immenfe ftrata. In warm climates it is procured by fpontaneous evaporation; but in cold countries it can only be procured by evaporation, the confequence of the application of heat. It is generally impure in its firft procefs, by the admixture of other falts, which render it deliquefcent, and give it a bitter tafte, and various proceffes are employed to purify it. In this laft ftate it acquires an agreeable, faline tafte. It is foluble in rather lefs than three parts of cold water, and is the fame in hot water. Its proportions are 35 parts of foda, 40 of muriatic acid, and 25 parts of water.

CCCCLXXXII.

Muriat of ammoniac is native, but for moft ufes is prepared by art, and chiefly by fublimation. It is acrid and urinous to the tafte. It diffolves in three parts and a half of cold water, and in equal parts of boiling water. Its proportions are 40 parts of ammonia, 52 of acid, and eight of water. It is decompofed by lime, and a cauftic, or pure ammoniac produced.

CCCCLXXXIII.

Fluates.

The fluates are as yet unknown in medicine, and therefore need only to be barely mentioned.

CCCCLXXXIV.

Borates.

The borates are diſtinguiſhed by communicating a green colour to the flame of alcohol.

The borat of potaſh is little known. The borat of ſoda forms the common borax of commerce. In its taſte it is cool, ſomewhat alkaline, and changes vegetable blue colours to a green. It is ſoluble in 12 parts of cold, and in ſix parts of boiling, water. Its proportions are 34 parts of acid, 17 of ſoda, and 49 of water.

Borat of ammonia can hardly be obtained in the ſolid ſtate, and has never been applied in medicine.

CCCCLXXXV.

Carbonates.

At this place it may be proper to conſider the neutrals formed by the combinations of the carbonic acid with the alkalies, forming a claſs named carbonates.

Carbonates poſſeſs the diſtinguiſhing property of effervеſcing, on being mixed with acids, the carbonic acid being thus detached from their baſe, and flying off in the gazeous ſtate.

CCCCLXXXVI.

Carbonate of potaſh, or aerated vegetable alkali, is uſually in the form of a white powder, of an acrid taſte, with ſome cauſticity, though not equal to the pure alkali. It is ſoluble in four parts of cold water. Its proportions are 23 parts of acid, 70 of alkali, and five of water. This ſalt may be varied in its proportion of acid, and accordingly it is formed occaſionally as a ſub-carbonate, or with an exceſs of alkali, and at other times as a ſuperſaturated carbonate, with an exceſs of acid.

CCCCLXXXVII.

Carbonate of ſoda is that ſtate in which ſoda is uſually prepared, combined with carbonic acid. It poſſeſſes an alkaline taſte, with little acrimony, and changes vegetable blue colours to a green. Its proportions in 100 parts are 16 of acid, 20 of alkali, and 64 of water. It is ſoluble in two parts of cold, and in its own weight of hot, water.

CCCCLXXXVIII.

Carbonate of ammoniac is a concrete ſalt, ſo volatile as to exhale at the common temperature. It poſſeſſes a pungent, ammoniacal odour and taſte, is ſlightly cauſtic, and changes vegetable colours to a green. It is ſoluble in twice its weight of cold water, and in leſs than its own weight of boiling water. Its proportions are 43 parts of alkali, 45 of acid, and 12 of water; though theſe vary according to the temperature at which it is formed, the proportion of the alkali being from 20 to 50 in the 100.

CCCCLXXXIX.

The vegetable acids, in the ſame way as the mineral, form with the alkalies different neutral ſalts; but theſe, except a few, are little uſed in medicine, and therefore claim ſlight attention, compared with the mineral neutrals. Many of them alſo have been ſo lately diſcovered, that their qualities are not yet appreciated We ſhall only therefore notice the few that are really known.

CCCCXC.

...nole

Tartar, or potaſh, ſuper-ſaturated with purified is known acid, is formed on the ſide of ... tartar, and requires for its fermentation of wine

K 6

under the n...

ſolution 100 parts of cold, and 28 of hot, water, though its ſolubility may be increaſed by the addition of borax. By the addition of potaſh the tartarite of potaſh is formed, a ſalt of a bitter taſte, deliqueſcent, and ſoluble in water. If, inſtead of potaſh, ſoda is uſed to neutralize it, Rochelle ſalt becomes the production.

CCCCXCI.

Oxalate of potaſh, or ſalt of ſorrel, is little uſed in medicine, but poſſeſſes the quality of eradicating ſtains from linen, and is much employed for this purpoſe.

Acetite of potaſh appears in the form of a white foliated maſs, extremely deliqueſcent, and is ſoluble in little more than its weight of cold water.

Acetite of ammonia can ſcarcely be cryſtallized, as it is partly volatilized with the water, when its ſolution is evaporated, and partly decompoſed.

CCCCXCII.

Of the animal acids, few or none, except ſome of the preparations of phoſphorus, have been introduced into medicine.

Phoſphate of ſoda is a cryſtallized ſalt, with a ſlight exceſs of alkali. It is ſoluble in three parts of cold, and in half that quantity of hot, water.

Phoſphate of ammonia is a conſtituent part in the urine of carnivorous animals. It is obtained pure by the direct combination of its principles. It is ſoluble in four parts of cold, and in a leſs quantity of hot, water.

CCCCXCIII.

The ... hitherto deemed the ... ſubſtances which have been ... in medicine, and

before the gazeous fluids were underſtood, they were conſidered as the moſt powerful agents in chemiſtry. Different theories of phyſic have been formed from their ſuppoſed action on the fluids, and an acquaintance with the gazeous bodies has again, in ſome ſort, renewed thoſe doctrines which the operation of the ſaline remedies originally introduced. We ſhall examine their effects, according to the arrangement already obſerved, proſecuting them firſt in their ſimple, and afterwards in their compound, ſtate.

CCCCXCIV.

In inveſtigating this ſubject, the firſt obſervation that occurs is, that we find no ſimple ſalt in the human body, but always in a ſtate of combination; and wherever it exiſts in a ſimple ſtate, it is the effect of diſeaſe, and of the action of the ſyſtem being improperly exerted, ſo that the connection of the ſimple ſalt with its baſe is prevented. This forms a leading clue to the uſe of ſaline remedies, and that where they are meant to paſs beyond the primæ viæ, or into the ſyſtem at large, they ſhould be introduced in their ſimple ſtate, ſo as to remove that deficient combination which diſeaſe, as its conſequence, produces.

CCCCXCV.

Our knowledge, however, of the animal fluids is as yet very imperfect, and the proportion of their component parts, in health and diſeaſe, has not been ſo far aſcertained as to lead to any regular concluſions on the ſubject. From the fluids, however, we know that the ſolids are entirely formed, and any cauſe which produces a change on the chemical combination or proportion of

13

their fluid parts, muſt influence the ſtate of the ſolids, and lay the foundation for diſeaſe. The humoral pathology, therefore, we ſhall always find juſt, to a certain degree, and that in chronic diſeaſes particularly it claims a greater ſhare of attention than it has yet received.

CCCCXCVI.

The uſe of alkalies againſt certain diſeaſes has been long known. Of all others, however, their effects againſt calculus have been moſt ſucceſsful; and this practice began ſoon after the commencement of the laſt century. They were firſt propoſed in the form of ſalt of tartar, and at a later period they yielded to that of ſoap and lime. But though the diſeaſe was mitigated, and the pain and irritation aſſuaged, ſtill their collateral bad effects were conſiderable, as they were often uſed to moſt enormous extent. To preſerve the efficacy of this remedy, and avoid its hurtful conſequences, the moſt rational expedient appeared to be, in ſome degree, to neutralize it. The alkali, therefore, ſuperſaturated with carbonic acid, was the form reſorted to with this intention, and the ſalt of tartar, in ſolution, was directed to be impregnated by means of the apparatus for impregnating liquids with fixed air, by expoſing the ſolution to a ſtream of it for 48 hours. The effects of this impregnation, while it alleviated its hurtful tendency on the conſtitution, were to produce, in many patients, thoſe ſymptoms which ariſe from intoxication, and which prevented its uſe to the extent their malady required. Hence it has been recommended in the form of the foſſil alkali, or ſal ſodæ, with ſoap.

CCCCXCVII.

The chief effect of alkalies, in any form in this diſeaſe, is to produce a ſpeedy and complete abatement

of pain. They are moſt effectual in caſes after the prime of life; and, indeed, this diſeaſe is moſtly confined to that period. Their mode of operation is ſtill undetermined. That a diſcharge of calculi, or gravel, follows their uſe, ſo ſoon as they begin to act, ſeems conſtant and regular; and that the ſecretion of urine is actually changed by them, is alſo aſcertained by the uſual teſt of turnſole. That an acid is preſent in the urine, chemiſtry has abundantly detected; and that this acid is much increaſed, in certain diſeaſes, has alſo been obſerved. From theſe facts, we have reaſon to infer that a chemical combination firſt takes place, and that the ſand or gravel which follows the firſt uſe of the alkalies, is the production of this combination, while the ſtate of the ſecretions is afterwards ſo changed, that the morbid exceſs of acid is entirely done away, and the oppoſite, or an alkaline diſpoſition, produced. The particular kind of this alkali, however, has not been examined; but ſo ſtrong is the power of acids in producing this diſeaſe, that patients have felt an immediate return of it from acids alone, eſpecially in the form of ſtale malt liquors. The ſame has been obſerved by many patients on the drinking of wine, and the ſimilarity between the concretions of this diſeaſe and of gout is a ſtrong confirmation of the ſame fact.

CCCCXCVIII.

Beſides in calculus, alkalies form remedies well adapted to the diſeaſes of infancy. During childhood a diſengaged acid is preſent in the primæ viæ, frequently in ſuch exceſs as to induce morbid ſymptoms. The alkalies here are the moſt ſucceſsful means of cure, joined with aromatics, and they are particularly indicated by the acid

ſmell of the ſtools. In general the volatile alkali is reckoned the moſt powerful.

CCCCXCIX.

Alkalies are alſo employed, with ſucceſs, in particular ſpecies of ulcerations, either when appearing as an original malady, or as a conſequence of venereal contagion, where an exceſs of oxygen has been introduced into the ſyſtem by means of mercury for its cure. The vegetable alkali has been here the remedy employed, and has often effected a complete removal of this ſtate.

D.

In ſcrofula the foſſil alkali is reckoned a very uſeful preparation, and frequently removes the obſtruction of the fluids, and it is uſed either in the ſal ſodæ, or burnt ſponge, both which derive ſo little advantage from their carbonic impregnation, that to the alkali alone the benefit attending their application is to be referred.

DI.

Externally the alkalies are frequently uſed as cauſtics, and the volatile kind makes a powerful rubefacient in caſes of fixed pain and ſpaſm.

DII.

From the alkalies we proceed to the effects of the acids; and on this ſubject, of the ſimple ſalts we may obſerve, that they are each a claſs of remedies of powerful operation, and that the continued uſe of either ſoon induces an actual morbid ſtate. This is particularly the caſe with the ſecond diviſion, or the acids. They conſiſt all, as formerly obſerved, of oxygen, with a combuſtible baſe. The proportion of oxygen neceſſary to the ſupply of life, from the quantity received by reſpiration, does not ſeem

to be very great, and an excefs of it will therefore act as a powerful means of inducing difeafe, in proportion to its efficacy as a remedy. Till the effects of refpiration, on the one hand, and the compofition of acids on the other, was fully known, no proper theory could be formed of the mode of operation of fome of the moft fuccefsful medicines in ufe. But by this knowledge we find that the moft powerful combinations are the effect of the oxygen they contain and impart, on their introduction into the body; and that to this principle their activity, as medicines, is owing. Hence the ufe of oxygen, in its greateft quantity and in its mildeft ftate, by means of the acids, has of late formed a new field of practice, and their powers have been particularly called forth to check the progrefs of one difeafe, the fpecific for which has been often attended with dangerous and fatal confequences to the conftitutions of patients. This is the venereal difeafe.

DIII.

The acid preferred for counteracting its contagion has been the nitric, as containing oxygen in the greateft proportion. It was firft brought forward to modern notice by Mr. Scott of Bengal. The variety of trials which have been made with it, and the affiduity with which thefe trials have been profecuted, we may confider as having exhaufted the fubject, and that the real merit of the acids, in this difeafe, feems fully appreciated. The candid conclufion to be drawn is, that they are medicines of much benefit in particular ftates of this malady, and thefe ftates we fhall endeavour to define with fome precifion. Wherever dyfpeptic fymptoms are prefent in a great degree, and much debility of conftitution prevails,

provided an actual hectic fever does not attend, the use of the acids will be highly serviceable. They will be found to improve the general health and strength. They may be therefore made either to alternate with mercury, or they may be given alone, till the constitution is so far repaired that it can sufficiently bear the action of the latter remedy. In peculiar cases of ulceration also, where mercury is found to increase the malady, the use of the acids is often astonishingly efficacious, both in an internal as well as external form. In venereal cases of old standing, particularly in affections of the bones, the exhibition of the acids, from the easily disengaged state of their oxygen, and their highly diffusible nature, is found to alleviate the symptoms in a very speedy and considerable degree. Nor are their advantages less extended to herpetic and other eruptions, over which they display the most marked success. The local inconveniences attending a course of mercury, particularly the profuse discharges, and foetid ulcerated state, is more speedily and effectually relieved by the internal use of acids than by any other medical treatment hitherto employed; and to counteract these effects, it may be trusted to with most implicit confidence. Neither in their exhibition should they be carried too far: but the propriety of their application is generally shewn very speedily, for if no improvement of the general health, or increase of vigour quickly occur, they are seldom effectual, and they may be laid aside.

DIV.

On the whole, the acids are by no means remedies of general and indiscriminate application in venereal complaints. They are suited to the particular situations we

have pointed out; and though a complete cure may not be effected by them, much relief will attend their exhibition.

DV.

The form in which oxygen is applied, as well as the principle itſelf, ſeems important to the cure of this diſeaſe. In the form of gas it poſſeſſes no influence at all. In the form of the acid it is ſpeedy in its relief, though not fully complete or permanent in the cure. But in the form of mercury, when it is united to a metallic baſe, and extricated in the ſyſtem, in this ſtate it proves, in almoſt every caſe, a certain ſpecific for this malady.

DVI.

By ſome authors it has been alleged, that the ſenſible effects of mercury and the acids are not ſtrictly analogous to each other, for the ſalivation induced by the acids, it is alleged, is different from that induced by mercury; that no looſeneſs of teeth attends it, nor the ſpongy gums, or fœtid breath. Of this, however, ſufficient obſervation has not yet been made; but if ſo, theſe ſymptoms would ſeem entirely the effect of the metallic baſe, not of the oxygenous principle of the remedy.

DVII.

As the acids are ſubſtances of ſuch powerful operation, ſo likewiſe we find their exhibition, as well as that of mercury, liable, in many conſtitutions, to produce dangerous conſequences. Theſe conſequences conſiſt in affections of the primæ viæ, as nauſea, vomiting, or flatulence, heartburn, and pain of ſtomach; or elſe heat of bowels, diarrhœa, dyſentery, or conſtipation; in affections of ſkin, as heat, itching, or miliary eruption;

in fever or nervous affections, and in several disorders of the secretions. These effects, however, are but rare, compared with the benefit derived from them.

DVIII.

But though the nitric we have mentioned as the acid most relied on in venereal complaints, the muriatic also deserves its share of credit. It was first introduced with this view by Dr. Zeller, and he found it particularly effectual in the venereal ulcerations of scorbutic habits, and where a dissolved state of the fluids was conspicuous. In such cases the advantages of its use were even more speedily conspicuous than those of the nitric acid; but it required to be used to considerable extent, in order to accomplish this effect.

DIX.

In the venereal disease the vitriolic acid has been the one of the fossil acids the least employed. It seems only to act here as a general tonic, without any appearance of specific operation; and its oxygen, therefore, is perhaps more fixed by its base, or not so easily disengaged as the others.

DX.

The vitriolic acid has been chiefly used as a temporary remedy, to prepare the constitution, in venereal cases, for the introduction of mercury, where a peculiar weakness of habit, dyspeptic symptoms, or profuse discharges, forbid the immediate exhibition of the specific. But it seems to have less power in arresting the progress of this disease than the other mineral acids, and is therefore by no means the most useful tonic, either to suspend its course, to heal its ulcerations, the consequence of the spe-

tific, or to leſſen the increaſed diſcharges from the latter. It has been much recommended alſo in cutaneous eruptions of the herpetic and pſoric kind, and here it has been attended with the moſt certain and marked ſucceſs, and is much more cleanly in its application than the ſulphur. But if this acid has been little uſed in venereal caſes, it has been more extenſively employed than the other two in a number of different maladies.

DXI.

The vitriolic acid has been employed very extenſively as a tonic in all caſes of paſſive diſcharges, and where no inflammatory diſpoſition of body is preſent. The muriatic acid, though not ſo generally employed, is poſſeſſed, as a tonic, of more active powers. In typhus it has been employed on the continent with moſt deciſive ſucceſs, and uſed in very liberal quantity. In the fevers of children it acts frequently as a ſpecific. Where uſed, however, ſimply as a tonic, in chronic caſes, it muſt be exhibited in ſmall quantity; but where it is had recourſe to in the active febrile ſtate, this rule muſt be reverſed. Externally the muriatic acid has been applied in the form of a bath to the feet, in gout. In a late publication there are accounts of its ſucceſsful application as a lithontriptic.

DXII.

Next to the mineral acids has been placed the boracic, but it has been chiefly uſed in the form of Homberg's ſedative ſalt, in which form it was ſuppoſed to poſſeſs powerful anodyne virtues, and from which it derived its appellation of ſedative. Theſe virtues have not been realized by ſucceeding practitioners, ſo that it is now

entirely laid aſide. The fluoric acid has not yet been introduced into medicine.

DXIII.

Of the vegetable acids, the citric claims the principal attention; it forms what may be conſidered as a ſpecific in ſcurvy. This diſeaſe, it is clearly eſtabliſhed, ariſes from a gradual abſtraction of oxygen from the ſyſtem; and the livid colour of the blood, and every other ſymptom, confirms it. Hence every means of ſupplying oxygen afford a certain chance of cure. But though this general principle is clear, and that the morbid ſtate may be removed by moſt of the remedies of this claſs, the citric acid has been found the moſt ſpeedy and effectual, and has therefore claimed a preference. Previous alſo to the introduction of the mineral acids for the cure of lues, the vegetable acids, in this form, we are informed, were employed for the ſame purpoſe. The particulars of this practice were the exhibiting to the extent of 11 or 12 Seville oranges daily, either in the pulp or ſtrained juice; but this remedy was found even leſs effectual than the mineral acids, and was hardly capable of at all ſuſpending the progreſs of the diſeaſe. In the warmer climates the citric acid forms a uſeful application externally to ulcerations, and is much employed for that purpoſe in the yaws and cutaneous diſeaſes.

DXIV.

Of the other vegetable acids, few are uſed in medicine, except the acetic and acetous. The malic is chiefly employed as an article of diet, in the fruit which produces it. The oxalic is alſo uſed only in the ſame way. The benzoic is a medicine of long uſe, under the name

of the flowers of benzoin. Formerly it was prefcribed in pectoral complaints, but with little efficacy. The acetous acid is the only one then of this clafs that claims farther notice. This acid is ufed very extenfively, both in diet and in medicine. In the latter cafe it is a ufeful antefeptic, and is applied in a variety of forms, both externally and internally, with this intention.

DXV.

All the vegetable acids form powerful antidotes againft narcotic or vegetable poifons, though the citric and acetous are chiefly had recourfe to with this view. Though modern chemiftry has detected a great variety of vegetable acids, yet the greater part of thefe feem refolvable into two, the oxalic and acetic; and from this circumftance they may be perhaps confidered rather as varieties of them, depending on fome peculiarities in their combination, than as original compofitions of this clafs.

DXVI.

Of the laft divifion of the acids, the animal, there are only two fpecies ufed in medicine, the lactic and phofphoric. The lactic is employed under the form of fugar of milk, and is made in Switzerland in confiderable quantities. It has been reckoned by fome, though on no good foundation, a fpecific for gout, though its fenfible qualities do not evince fufficient powers to have any influence over this difeafe. The phofphoric acid is a medicine of peculiar properties, although thefe have not yet been fully appreciated. From the reports, however, of the German phyficians, we are induced to confider it as exerting a powerful ftimulant operation on the fyftem.

DXVII.

From the experience of thofe who have employed this remedy, it is found well fuited to thofe low ftates either of fever or nervous affection, where a powerful and univerfal ftimulus is wanted. It produces, by its action, an univerfal heat and glow, and quickens the pulfe, rendering it at the fame time ftrong and full. It is one of thofe rapidly exciting means which is only fafe where the vital powers are extremely low. Hence it has been ufed with much fuccefs in typhus, even after the worft fymptoms have appeared, as involuntary ftools and difcharge of urine; and its effect has been to reftore the natural animation of the fyftem, to produce an increafed vigour and glow, and to follow up this with a full and general perfpiration, fo as to terminate the difeafe. But like other powerful medicines, this remedy has often been attended with the worft confequences, where improperly ufed, and it is only in cafes where every chance of recovery is paft, and where the vital powers feem as it were altogether fufpended, that its moft fuccefsful operation has taken place. Indeed the accounts narrated of it, in fuch cafes, favour fomewhat of the marvellous.

DXVIII.

Such is the general action of the fimple falts, a form in which they are never naturally prefented to us in the human body. To produce, however, great or permanent changes as medicines, it is in their fimple form that they ought chiefly to be exhibited. From the time that chemiftry made fome progrefs, the exhibiting them in their compound ftate was preferred, and the labours of chemifts were chiefly employed to find out combinations which

ſhould poſſeſs qualities for the eradication of diſeaſe, ſuited to the chemical ideas or theories of medicine then prevalent. The general effect of the compound ſalts is to open the ſeveral excretions in a greater or leſs degree, particularly thoſe of the inteſtines and kidneys, &c. We may therefore perhaps infer, that an effect of the preſence of compound ſalts in the blood is to act upon the ſecretions, and render the uſeleſs parts of the fluids more eaſily determined to thoſe organs which are to ſeparate them, and make them paſs off, and thus to prevent an exceſs of azote being formed.

DXIX.

The combinations with the ſulphuric acid compoſe the firſt diviſion with the neutral ſalts. The two firſt articles, the ſulphates of potaſh and ſoda, are merely purgative, and poſſeſs no other operation. The ſecond of them is preſent in ſeveral mineral waters, and gives them a laxative tendency. It is more ſoluble in the animal fluids than the firſt, and is accordingly more active in its operation. The ſulphat of ammonia is not uſed in medicine.

DXX.

The ſecond diviſion, or the combinations with the nitric acid, are more extended in their operation on the animal œconomy, at leaſt the firſt of them, the nitrat of potaſh, or common nitre. It is conſidered to have a conſiderable influence in lowering the frequency of the pulſe. Hence it is employed as a refrigerant and ſedative in all active inflammatory ſtates; and by particular combinations it is brought to act powerfully both on the kidneys and ſkin. In the form of gunpowder it is employed by ſome practitioners, as a moſt ſucceſsful remedy in dropſy.

The nitrates of ſoda and ammoniac are not yet known as medicines.

DXXI.

The combinations with the muriatic acid follow next in order, and they are highly ſubſervient to the various purpoſes of life, both in diet and medicine.

The firſt of them, the muriat of potaſh, was formerly held in high reputation in fever, under the name of the febrifuge ſalt of ſylvius. This reputation it is no way entitled to, in preference to many other ſubſtances of this claſs, and it has accordingly been neglected. This ſalt is preſent, in a certain proportion, in the animal fluids, and oxygenated it has lately been introduced as a new remedy in venereal ulcerations.

Muriat of ſoda is more employed by mankind than any other ſaline ſubſtance whatever. It forms, as it were, a neceſſary ingredient in the animal œconomy, and the analyſis of all the fluids and ſolids detects its preſence.

The muriat of ſoda poſſeſſes evidently, out of the body, an antiſeptic power on animal ſubſtances. At the ſame time, taken in too largely during life, it haſtens the ſeptic proceſs, and proves one of the chief ſources of one diſeaſe, the ſcurvy at ſea. That its uſe ſeems neceſſary to the animal ſyſtem appears from the ſtrong deſire that many animals diſcover for it, and they are generally fattened with half the quantity of food by its uſe. This will tend to confirm the opinions lately adopted, of the formation of fat depending on the deficiency of oxygen in the ſyſtem.

The muriat of ammoniac is alſo a medicine of conſiderable utility. It is uſed internally as a powerful ſtimulant, and antiſeptic remedy, in intermitting and ſome other fevers; and externally, it diſcovers ſtrongly

the ſame qualities in gangrene and aſthenic inflammation of particular parts. In ſome ſpecies of inflammatory tumours and obſtruction, it proves a moſt ſucceſsful diſcutient.

DXXII.

Of the diviſion of carbonates, the two firſt have been chiefly employed, as we formerly noticed under the head of alkalies, for the cure of calculus, and the bad conſequences attending a conſtant and large uſe of the alkalies has been ſuppoſed counteracted by this combination.

Carbonate of ammonia is much employed as a cordial and exhilarating remedy in nervous caſes. It was ſuppoſed alſo ſpecific againſt the morbid effects of the poiſon of the viper; and from this circumſtance its exhibition was extended to venereal complaints. But in this laſt diſeaſe, although it occaſionally relieves ſymptoms, ſuſpends the progreſs of the malady, and gives eaſe in pain, it by no means has any claim to ſpecific powers. From its ſtrong ſtimulant nature, this combination has an influence on all the ſecretions, and will therefore be uſeful in every caſe of obſtruction, where no phlogiſtic diatheſis attends.

DXXIII.

The combinations of the boracic acid are little uſed in medicine. The ſedative ſalt was already noticed, and the powdered borate of ſoda is a common application to aphthæ.

DXXIV.

Of the vegetable acid combination, the chief uſed in medicine are thoſe with the tartarous and acetous acids. The purified acidulous tartarite of potaſh forms a uſeful

diuretic in dropſy, and is a ſafe mild laxative in all inflammatory ſtates. The real tartrite of potaſh, or ſoluble tartar, poſſeſſes the ſame properties, and the tartrite of ſoda is equally efficacious.

The acetite of potaſh is now little uſed, but it formerly had reputation as a powerful deobſtruent remedy, and the combination with ſoda poſſeſſed the ſame properties.

The ammoniacal acetite is now in moſt repute, and its ſolution is conſidered as a mild diaphoretic in all inflammatory diſeaſes, where an attempt is made to remove the morbid conſtriction of the ſkin, and it forms a gentle diſcutient and antiſeptic in caſes of external inflammation and ſwelling.

DXXV.

Of the combinations with the animal acids, few or none have been introduced into medicine. The only one to be noticed is the ſoda phoſphorata, which was conſidered as a laxative, acting without producing any griping or pain, and therefore as claiming a preference over the other ſaline remedies of this nature; but experience has by no means juſtified this opinion of it held out.

DXXVI.

From this view of the claſs of ſalts, conſidered as medicines, it would be of much importance, in order to their application in the compound form, that their relative exiſtence and proportion in the animal ſyſtem could be more fully aſcertained. By this knowledge alone could a proper ſelection of them, as remedies, be made. A diſengaged acid we find frequently preſent in the primæ viæ, but it ſeems to paſs no way farther. An alkaleſcent ſtate is

clearly marked in various cafes of difeafe. The compound falts are procured, in different proportions, from almoft every part of the animal frame. All thefe circumftances give an importance to this clafs of fubftances, which calls for the inveftigation of the phyfician into their fpecific relation to the human body, as a foundation for their fuller application to the cure of difeafe.

DXXVII.

CLASS V. *Earths.*

Earths, the fifth clafs of bodies, may be divided into five different kinds; and thefe kinds are,

1. The abforbent or alkaline earths; 2. The clays; 3. The flinty or filiceous earths; 4. The fufible earths; 5. And laftly, the talky or flexible earths.

DXXVIII.

The abforbent, or alkaline earths, are found of many degrees of firmnefs or hardnefs, from the ftate of loofe earth to that of hard ftone; but they never fcratch glafs, or give fire with fteel; and by applying the edge of a knife, an impreffion may be made upon them. Their moft diftinguifhing and moft remarkable quality is, that of effervefcing with acids, which may be obferved by applying a fingle drop of aqua fortis to the furface of this kind of earth, when it immediately works upon it, and rifes into foam.

DXXIX.

The clays are friable or moift earth, which mixed in a certain proportion with water, forms a tough or ductile pafte, and when burnt they become exceffively hard, but cannot be melted in any ftrong fire.

DXXX.

The flinty earths comprehend always the hard stony masses of various sizes, the principal quality of which is excessive hardness; it is so great that these bodies cut or scratch glass, as the diamond does, though not so effectually; and they give fire with steel, or when struck in a particular manner, they throw out flashes of fire. The particles of steel being torn off, are afterwards in a state of calcination, and a file makes no impression on them; but, on the contrary, they wear down the file.

DXXXI.

The fusible earths comprehend firm stony concretions, that are neither so hard as the flinty, nor so soft as the absorbent earths. They have a middle degree of hardness, but do not strike fire with steel. Their most remarkable and distinguishing characteristic quality is their fusibility, which appears in them when they are strongly heated.

DXXXII.

The last class, the talky earths, are concretions of a scally, flat, or fibrous structure. They have no great degree of hardness, they are easily scraped with the knife, and their distinguishing quality, besides the structure mentioned, is, that they suffer very little change upon being exposed to a pretty strong heat.

DXXXIII.

In considering the origin of these earths, it may be remarked, that surveying the face of the globe, and the accidental changes it has undergone by water and other causes, and especially by going into its bowels, it can be

obferved, that it is either formed into beds or layers, parallel to one another, or into maffes enormous in their fize, but quite irregular in their thicknefs and external form; the firft are called ftrata, the fecond rock, or rock-ftone.

DXXXIV.

Thefe appearances are not to be perceived at the furface, which is every where covered with a confufed rubbifh of the materials, which lie more folid and regular below, and a part of which has been often broken down, and carried to a confiderable diftance, by the water moving along, and by other caufes; but this rubbifh muft be broken through before thefe appearances can be feen.

DXXXV.

An example of what has been mentioned is to be found near Edinburgh, at the north end of Salifbury craigs, where a confiderable part has been carried away. The ftratified matter may be feen very diftinctly, and the rocky ftone, the greateft part of the ftratified matter underneath confifts of parallel beds or layers, a little interrupted here and there; but the number is exactly the fame through all that part, and the thicknefs of each bed is precifely the fame through the whole of its extent. Over this there is an example of the ftony matter called rock, a mafs of matter the parts of which are not arranged in any regular order; over this again there is an example of a fmall quantity of matter ftratified, fimilar to what is below; and appearances fimilar to this are to be found every where, in digging deep into the earth.

DXXXVI.

In general the quantity of ftrata exceeds very greatly

that of the rock, eſpecially in countries that are tolerably ſmooth and even. Such are compoſed of ſtrata of an equal thickneſs, through a great extent of country, ſo that when the workmen ſink a ſhaft into a mine or coal-pit, they know the materials they have to paſs through. If they have to ſink another, at a conſiderable diſtance, they meet with, perhaps, a bed of clay, then of ſand, then a quantity of more clay, after this free-ſtone, &c. And if they have occaſion to ſink another, at the diſtance of many miles, they will paſs through the ſame materials, of the ſame thickneſs, and arranged preciſely in the ſame order. So theſe are ſpread out and extended in this manner, in beds of equal thickneſs, to a great extent of country. At the ſame time this regularity is chiefly to be met with in countries that are ſmooth and even upon the ſurface; it is more general, where the ſurface is uneven, to find the ſtrata inclined to the horizon, or, to uſe the term of miners, dipping; and ſometimes they dip in one place and riſe again in another, and perhaps again deſcend, ſo as to follow the waving of the ſurface of the ground; at other times they ſink much farther down. Wherever the degree of ſtrata comes up to the ſurface, as in the cutting of roads on the banks of rivers, &c. we have ſuch an appearance of the edges of ſtrata at the ſurface of the ground, and theſe are called cropping of the ſtrata; and it is this that produces a variety of ſoils, which are compoſed entirely of a rubbiſh of theſe materials that are lying more ſolid below, intermixed with the putrid remains of animal and vegetable matters.

DXXXVII.

Such is therefore the diſtribution of the materials on

the ſmoother parts of the earth; but in the mountains we find a greater quantity of rocks, which having been ſurrounded or intermixed with the ſofter parts, has withſtood the impreſſions of time, and now remains, after the other places are waſhed away. In this way are produced many mountains and extenſive ridges, which from their form ſhow they are the cropping of hard ſtrata, the ſofter parts of which have not withſtood ſo well the waſte of time. Generally on the one ſide is a little declivity, and the other ſide a ſteep, with a quantity of rubbiſh at the bottom, fallen from the top.

DXXXVIII.

It is neceſſary to obſerve, that both theſe ſtrata and rocky maſſes are found cracked, or broken acroſs in different directions. The more general direction is perpendicular, and theſe rents and diviſions are generally filled with ſome other matter different from that which compoſed the rock or ſtratum. Theſe are called veins in mineralogy, the matter filling them up is very various; but it is generally a ſtony matter of a foliated ſtructure, to which the general name of ſpar is given, which turns out various on different occaſions, every ſtony matter thus formed of hard and rocky matter being called ſpar. Theſe rents or cracks are of different wideneſs, from a few inches, or parts of an inch, to ſeveral feet or yards; and it is in the matters that fill them up that the ores of metals are generally found.

DXXXIX.

There are ſome diviſions that are met with of ſofter ſtrata, conſiſting of other matter not of the ſtony kind, and theſe are called banks by the miners or colliers, and

they prove a great interruption to the working. When there is thus a ſudden interruption of the whole ſtratum, and it entirely diſappears, the colliers proceed further till they come to other matter; from examining which they form ſome judgment where the coal lies, that it is either below, or ſomewhat above the level in which they have been working. Having paſſed ſuch a ſtratum of matter in ſinking before, experience has taught them the different ſituation of the materials to one another; and very often the ſtrata is diſturbed in this manner, that there is a diviſion or rent formed, and along with this the ſtrata has ſlipped a little below the level where they are working. Thus from their knowledge of the nature of the ſtrata, they conclude that the coal is below them, and they ſink down to get at it; or upon other occaſions they find it riſen. Theſe are called ſlips, where there is ſimply a diviſion or change of the level. Where they are placed at a diſtance at the ſame time, and a great quantity of matter introduced, that is called a bank, or they give it the name of a *trouble* or *diſturbance*, in the arrangement of the ſtrata.

DXL.

With regard to the veins, we find maſſes of rock and harder ſtrata; that wherever any part is left not filled up with the ſpar, where there are any holes, the internal ſurface is beſet with cryſtallizations of the matter with which the veins are filled. Theſe are of various kinds of ſpar, and other ſtony matters, formed into regular cryſtalls; and even the metallic ſubſtances are cryſtallized in the ſame manner, when they are found in ſuch veins.

DXLI.

Such are the phenomena in general that have been obſerved with regard to the earthy and ſtony matters of this globe; and the ſame phenomena have been obſerved over the whole of its ſurface. They are ſo curious, that they could not fail to produce many attempts to explain them. Many conjectures have been offered to account for their origin, and it will be found that, in general, all thoſe who have made any attempts of this kind, have gone upon the ſuppoſition that the general arrangement has been performed by means of water; that this regular diſtribution into ſtrata is in conſequence of a diffuſion and ſeparation of the materials from water; and when the arguments upon which this ſuppoſition is founded are well conſidered, they no doubt give an undeniable proof that this is the caſe; becauſe we find in theſe ſtrata either the relicts of marine productions, as ſhells, &c. or, at leaſt, there are none of the ſtrata but what are either above or below ſtrata that manifeſtly contain the productions of the ſea. When this fact is well conſidered, it is an undeniable proof that this regular arrangement has been produced by a depoſition of its materials, gradually from water, perhaps in the bottom of the ſea. But beſides this regular arrangement of the ſtrata, there are many other facts that cannot be explained upon this principle. The inclination to the horizon that is ſo remarkable in the ſtrata in moſt places, which is ſometimes ſo great as to place them upon their edges, cannot be explained in this way; nor the extenſive ridges of mountains in which the ſtrata are very often thrown into great confuſion.

DXLII.

Some have ſuppoſed that this kind of confuſion, and theſe diviſions and rents, have been occaſioned by repeated earthquakes, which we know produce effects ſimilar to this. We have records of conſiderable tracts of countries being ſuddenly laid under water, and of iſlands appearing raiſed from the bottom of the ſea, in conſequence of eruptions of burnt or melted matter, produced by ſubterraneous fires or volcanoes, which continued raiſed to a conſiderable height above its ſurface. Others have ſuppoſed that this happened at the deluge, which threw the world into a ſort of confuſion, compared with the ſtate it was in before. Others have ſuppoſed that this world received a ſtroke from a comet, which by the violent ſhock has thrown its materials into confuſion. And Buffon again imagines that the ocean is making a gradual progreſs over the ſurface of the globe, wearing away from ſome ſhores and adding to others; ſo that there is not a ſpot of the globe that has not been once covered with the ſea; and that thoſe parts preſently covered with the ſea are receiving an addition of matter that will prove ſufficient to raiſe them over its ſurface, in a certain length of time. But we cannot enter ſo particularly into this ſubject, as to explain all the theories that have been offered. Upon the whole, the phenomena ſhow that the materials of this globe have undergone a very great changes; that what was once covered with water is now mountainous, and what was once above the ſurface is now at a great depth under water; and that theſe changes have been often repeated, though the ſucceſſion of them has been extremely ſlow, and has required a very great length of time.

DXLIII.

Of the abſorbent or alkaline earths, there are ſeveral kinds which are inſipid bodies, and ſhew no ſenſible degree of ſolubility in water. Their character is, that they effervefce with acids; and ſuch is their nature, that they bear plainly the ſame relations to acids as alkalies do, ſo are frequently called alkaline earths. In general, they unite with acids only in one certain and ſteady proportion. If there is more of the abſorbent earth added, it is not all diſſolved; or if a ſmall quantity only be mixed with the acids, leſs than what the acid can diſſolve, it is only united with a part of the acid, and the reſt remains free and diſengaged. There is the ſame mutual ſaturation here, as between the alkalies and acids, and the compound is analogous to the neutral ſalt. It is ſoluble in water, and ſeparable from it by evaporation and cryſtallization. The acid is hereby fixed, and its acrimony greatly diminiſhed. No acid taſte is perceivable in the compound; it does not alter the colour of the vegetable infuſions; and theſe earths attract the acids preciſely in the ſame manner as they are attracted by the alkalies. So they reſemble the alkalies in every particular, almoſt with regard to the nature and mode of this attraction; but the force, upon the whole, is weaker than that of the alkaline ſalts, ſo that any compound of them can be decompoſed by an alkali, and the abſorbent earth be made to fall down in the form of a white powder.

DXLIV.

Theſe properties are applicable to the earths in general. We ſhall next conſider the various kinds of

them. That which occurs the moſt copiouſly, being at the ſame time the moſt uſeful, is the

DXLV.

Calcarious Abſorbent Earth.

It is diſtinguiſhed from the reſt, by the effect which fire has upon it, which converts it into quick-lime, from whence it has its name of calcarious. It appears in a variety of forms. There are very conſiderable ſtrata of it in the bowels of the earth, as lime-ſtone, marble, and chalk, which differ only in the degree of purity, or mode of concretion, forming a maſs, the parts of which cohere more or leſs ſtrongly.

1. There are as extenſive beds of this ſpecies of earth found as of any other kinds whatever; ſo may be conſidered as among the moſt abundant production of nature.

2. It is often alſo found in veins, or filling up the rents and cavities of the mountains; and it is called calcarious ſpar, to diſtinguiſh it from ſome other kinds of ſpar, ſome of which contain a quantity of this earth, but not in ſo pure a ſtate. It reſembles a whitiſh ſtone, which has more or leſs tranſparency, when it is called ſpar, and when it is broke into pieces it is of a rhomboidal figure, and it ſhews, at the ſame time, manifeſtly a foliated texture, when it is examined by the microſcope. Some of theſe kinds that are purer, are perfectly tranſparent; and from their being found in Iceland, this ſpecies is called Iceland cryſtals; but that name belongs to a different kind of ſtone. This tranſparent ſtone is remarkable for refracting light, ſo as to make a ray of light appear two, without at the ſame time diſperſing the colour; it makes every letter or

ſtroke of writing appear double. In the veins of the calcarious ſpar, where any part is not totally filled up, the internal ſurface is found lined with cryſtallizations. The appearances of theſe are very various, the cryſtals being formed into a number of different ſhapes. What particular circumſtance influences them to aſſume theſe particular appearances has not been diſcovered. Some of them are pyramidical, others are columnar of ſix ſides, the two ſides oppoſite being always unequal, and terminated by a very obtuſe pyramid; or the cryſtals are flat, without any column that is perceptible. In others the pyramid is a little longer, with a ſhort column, or the ſpar is formed into long cryſtallizations, cloſely compacted and diſpoſed in a radiated ſhape, proceeding from a central point towards the circumference of a ſphere, &c. Theſe cryſtalliſations are always found in the internal ſuface of veins, the other parts being filled up with calcarious ſpar.

DXLVI.

The matter with which the vegetable and animal matters are incruſted or penetrated by the waters of particular ſprings, ſo as to retain not only their external form, but to loſe their nature, and become ſtone, is generally of this kind. This ſhews that this earth is capable of being diſſolved by water, and of being introduced into the texture of animal and vegetable ſubſtances. We have examples of this in England, at the dropping well at Knareſburgh, and in Hamilton park, in Clydſale in Scotland. In general, the quantity of earthy matter is very ſmall in theſe waters that are poſſeſſed of this petrifying power, and the proceſs of petrifaction goes on very ſlowly. This earth too produces the large pen-

dulous columns and cones that are found hanging from the roofs of large caves, like icicles formed in frosty weather. A noted example of this is a cave at the Peake in Derbyshire; they are called stellactites. On other occasions, this matter concretes into a more spongy and irregular form; it encrusts the surface of the rock, or forms broad hanging plates, like curtains.

DXLVII.

The stony shells of all crustaneous animals, from the coarsest to the coral and pearl, are all composed of this earth and a small quantity of animal glue; a viscid fluid proceeds from the surface of the animal, which becomes a tough membrane, and gradually hardens into this form. So egg shells, and these marine bodies, which from their resembling plants, while at the same time they have the hardness of stone, are called lythophyts, millepores, madripores, &c. which the late naturalists now suppose to be in part animated bodies. The shells of all kinds of animals, together with all coraline concretions, consists of the calcarious earth, united only with a small proportion of animal glue.

DXLVIII.

Under these four forms the calcarious earths have generally a great degree of variety. But there are some fossil earths, which though not consisting entirely of these, deserve to be mentioned, as the earths called marles, which have been employed as manure to improve the soil. Every such substance that thus proves a manure, contains a calcarious earth, and is rich in proportion to the quantity of this. The earths of this kind are com-

monly divided into the shell marle, clay marle, and the stone marle.

DXLIX.

The shell marle is composed of the shells of shell fish, or other aquatic animals, which are sometimes very entire, and often decayed, or mixed down with other earthy substances. Examining this matter as occurring in different places, it may be distinguished into fresh water, marle, and marle of sea shells. Of the first we have an example in Bruntsfield meadow near Edinburgh; wherever the soil is turned up, to the depth of six inches, a quantity appears; it is composed of the shells of a small fresh water wilk or snail. This animal, when alive, is not easily discernable, the shell being much of the same colour as the stones covered with the water; but we can observe a great number of them in all running brooks and other collections of fresh water; when the animal dies the shells are deposited, where the water stagnates, in very great quantity. That composed of sea shel s constitutes greater collections, and they are found in innumerable places, now far removed from the sea. That most particularly described is a collection of this kind in Touraine, a province in France. The part of the country where it is found, is computed to contain 80 square miles of surface, and where they dig to a certain depth, they find this collection of shells; and the country, at present, is 108 miles from the sea. They find the marle eight or nine feet below the surface, and when they dig to the depth of 20 feet it is still deeper, but they find it too expensive to search for it. It is supposed to be 28 feet deep only; and even at this depth the quantity will appear enormous,

it will amount to 140 millions of cubic fathoms of shells, that are mostly decayed and broken into fragments, and mixed with marine productions, as millepores, madripores, and other caroline, which are all the productions of the sea.

DL.

The clay marle, again, are earths that bear more or less resemblance to clays. They are very various in their colour and other appearances, and disagree in nothing, except their containing a quantity of clay mixed with calcarious earth. Frequently the colour is reddish, sometimes of a bluish cast; others, again, are of a yellowish colour; but all agree in containing a quantity of clay mixed with calcarious earth, so as to effervesce with acids.

DLI.

The stony marles have as great a variety in their colour and appearance. They are harder and more stony than the clay marles; but upon being exposed to the action of the sun and of frost, they fall down into clay, which is easily mixed with the soil, though some of them require a very long time before they are divided fine enough to be mixed completely with it; and this disposition to moulder down, depends upon an admixture of clay.

DLII.

These are therefore the various forms in which the calcarious earth is offered to us by nature. Many of these forms are capable of receiving a fine polish, and many of them prove beautiful on account of their colour, and from hence arises their value. So coal is valued on

account of its colour and hardneſs, ſo that its parts can be made to receive a high poliſh. Alſo the lime-ſtone that is called marbles, in which this matter is concreted more firmly, ſo as to have a much cloſer texture, and to receive a fine poliſh, and ſome of the ſtellactites, which can be made into toys, receive a fine poliſh. The variations ſometimes depend upon veins of ſpar traverſing through them, ſometimes upon ſhells and other marine productions, and they ſometimes proceed from an admixture of various coloured earths, mixed with the calcarious matter, of which they are chiefly compoſed.

DLIII.

Some compounds that have calcarious earth for their baſis, fall next to be noticed.

The firſt are the gypſeous concretions, that are commonly repreſented to us in the form of ſtony maſſes, which are remarkably ſoft, ſo as to be eaſily ſcraped with a knife. They do not effervèſce with acids, like the calcarious earth; but when reduced to a powder, and boiled with a ſolution of the common fixed alkali, for ſome time, they change into a vitriolated tartar. They are found in ſtrata of clay, in ſeparate maſſes, and when pure are of a whitiſh, delicate, milky colour, and ſmall pieces of them are often tranſparent, tinged with a reddiſh earth. They are often compoſed of ſmall cryſtalline grains, and this ſpecies is called gypſum, or ſometimes alabaſter, where it has a conſiderable degree of hardneſs, and is capable of receiving ſome poliſh, ſo that ſtatues made of it imitate thoſe of marble. Beſides they are often formed of a fibrous ſtructure, and compoſed of oblong concretions lying acroſs the maſs, and they are called the fibraria of

Dr. Little, but they do not differ from the reſt, except in the particular arrangement of the particles.

DLIV.

A third ſpecies, compoſed of clear tranſparent plates, which can be eaſily ſcraped with a knife, is found in ſome parts of Ruſſia; their plates are ſo large as to anſwer the purpoſe of glaſs. It is called glacies mariæ, or Muſcovy talk.

DLV.

A fourth appearance is in the form of ſtraight oblong cryſtals, and then it is known under the name of ſelenites, and does not ill reſemble the cryſtals of ſalt.

DLVI.

Fifth. One of the kinds of ſpar contains a large quantity of this earth. It does not effervesce with acids, and is diſtinguiſhed from all other ſtones, by its extraordinary weight, which is ſo great as to give a ſuſpicion of its containing a great quantity of metallic matter. It has always a plated ſtructure, and broken with a ſmall throw, it ſhivers into fragments of a rhomboidal figure. It is called the marmor metallicum, from its being the matrix in which the metals are often found. It is compoſed of gypſum, combined with a ſmall quantity of other earth.

DLVII.

Laſtly, it occurs alſo in water, and there in a ſmall quantity; it always forms into ſlender filamentous cryſtals, like hair.

DLVIII.

There is a third ſpecies of ſpar, which has been long

known in chemiſtry and natural hiſtory, as being different from the calcarious and gypſeous ſpar; it is called the German felt ſpar, fluor, ſpatoſus, &c. as it aſſiſts in melting the ore from ſtony matter. It is always found in veins never conſtituting ſtrata; it has a cloſe glaſſy texture, and is more or leſs tranſparent. It is often found cryſtallized in the cavity of the veins, and always forms cubic cryſtallizations that are ſometimes colourleſs, but more commonly tinged either greeniſh, yellow, or purple. There are great quantities of it found in Derbyſhire, which, on account of the particular arrangement of the cryſtals and flaws dividing them, gives them a very remarkable appearance, when poliſhed.

DLIX.

The ſecond diviſion of earths is into clays, which are among the moſt abundant ſubſtances in nature, conſtituting numerous ſtrata in the bowels of the earth. Hence clay is often employed as a manure for improving the ſoil. A ſoil that conſiſts of pure ſand is the better of clay; and when it is uſed in this manner it is called marle; but that name is more properly applied to clay earths that contain a quantity of calcarious matter, and which is a uſeful addition to any ſoil whatever, even where there is plenty of clay, provided it has not received calcarious earth before. It is a ſubſtance, the particles of which are very fine and ſmooth between the fingers. A maſs of it has the ſame ſmoothneſs of ſurface as a maſs of hard ſoap.

DLX.

Clays, in their natural ſtate, are always moiſt. When dried, the parts cohere ſtrongly together, and in that

ſtate it has a ſtrong diſpoſition to imbibe water. By ap-plying a maſs of it to the tongue, by the ſudden abſorp-tion of the water, it generally adheres to its ſurface. When it is mixed with a large proportion of water, and kneaded a little, it becomes a remarkable ductile, ad-heſive maſs, which is not eaſily fuſible in more of the water, and to render it thin it requires a great deal of work. Hence it is employed as a means of confining water in large works, as in making canals and dykes. Either the ſoil muſt contain clay, or a quantity brought by the water is depoſited at the bottom, that renders the dyke capable of containing the water. Hence we can underſtand the bad effects that ariſe from allowing cattle to tread much in clay grounds, when they are wet; the clay is reduced to ſuch an adheſive maſs, that it does not admit the roots to penetrate the ſoil, or the water to enter to the roots.

DLXI.

Though theſe are the moſt obvious qualities of this ſort of earth, the variety of clays is very conſiderable, with reſpect to the fineneſs and ſoftneſs of the particles. Some melt with the ſaliva in the mouth, others feel more or leſs gritty between the teeth. Some are of a whitiſh colour, ſome grey, bluiſh, or reddiſh. Clay is more or leſs diffuſible in water, ſome of it becoming quite pulpy with it, ſome of it reſiſts the moſt violent fire without melting; others melt into a ſpongy or vitrified maſs. Some produce an efferveſcence with acids, others do not. Some are called boles, that conſiſt of fine, ſoft particles, and are noted for a particular colour, as red, blue, or yellow. Theſe were formerly in high eſtimation, from

their medicinal qualities, and were brought from the moſt diſtant parts of the world; and as it was eaſy to imitate theſe, it was neceſſary to ſtamp them with ſeals, as a proof of their being genuine, ſo they were called terra ſegillatæ. But we generally find a large admixture of ſand in them, and in general all the clays that feel gritty, derive this quality from the ſandy, calcarious, or other particles. An eaſy way to ſatisfy ourſelves of this, and to obtain the clay earth in a purer ſtate, is to mix it with water, to the conſiſtence of milk or cream, when the ſand ſettles to the bottom firſt, and we can pour off the muddy water containing the clay. This is called elutriation in chemiſtry.

DLXII.

The variety of colour in clays depends upon iron in moſt caſes, which can be extracted from a great variety of them, eſpecially thoſe that burn red in the fire. There are ſome mixtures of this kind that are ſo rich in iron, that they are melted, and the iron extracted with profit. In others the colour is from an inflammable matter, and theſe are diſtinguiſhed by burning white, when expoſed to heat in a proper manner.

DLXIII.

From this view of the variety produced among the clays by theſe admixtures, will be underſtood whence ariſes the variety in their qualities; why ſome effervеſce with acids; why moſt melt, when expoſed to a violent heat, as we find the addition of earthy ſubſtances to clay diſpoſes it to melt, particularly that the calces of iron have that effect.

DLXIV.

The kind of clay which is reckoned the pureſt, is that employed in the manufacture of tobacco pipes. It is generally of a whitiſh grey colour; but it is a neceſſary quality that it acquire a fine white colour, when expoſed to a certain degree of heat. It contains but a ſmall quantity of ſandy matter; it is ſmooth and unctuous between the fingers. It does not produce any effervefcence with acids; it forms a paſte that is ductile in water, and, when dried and burnt, it becomes as complete and hard as flint. At the ſame time, no degree of heat yet tried is capable of bringing this clay into perfect fuſion; it only ſoftens it, makes the paſte unite together, and to undergo ſome approach to fuſion. The tobacco pipes are burnt only with a moderate heat, and by increaſing the heat, they can be made much harder. If any ſmoak is admitted to it, it is liable to loſe its white colour, and the common way of burning ware is by putting it into earthern veſſels called ſeaſer or ſafeguards. If the flame was admitted to it freely, the ware would turn out black.

DLXV.

From theſe properties, clay is uſeful for forming chemical veſſels; but it forms them very compact, and not fit for bearing ſudden changes of heat and cold. Sand is therefore added, and a mineral ſubſtance called black lead, or talk. It is not eaſy to ſay in what manner theſe additions produce their effect; but when they are added in a certain quantity, the veſſels endure theſe alterations much better.

DLXVI.

The third divifion of this clafs is the flinty earths. Their diftinguifhing character is their extreme hardnefs; they fcratch glafs, and ftrike fire with the hardeft fteel; a part of the fteel is tore off with fuch violence as to be heated red hot; and flying through the air, it is blown up into a ftate of inflammation. This earth is alfo called cryftalline and vitrefcent, occurring in the form of regular cryftals, and it is the principal ingredient in the better kinds of glafs. It is fuppofed to be pureft when it is tranfparent and colourlefs, or it has only a whitifh or milky tranfparency, when it is called quartz; but it often occurs in an impure ftate, when the appearance is various. When it has a horny appearance it is called flint filex.

DLXVII.

Thefe are the fhapes in which it is fuppofed to be perfect, but it often occurs impure, and the appearance is various. 1. It is found conftituting ftrata in the fand, gravel, &c. Some fands are perfectly white, and are found to confift of grains of pure quartz. Gravel is much of the fame nature with fands, and forms confiderable ftrata mixed with fand. It confifts of this matter in large grains and maffes, but is feldom pure; it poffeffes an admixture of other matters. Pebbles are fome of thefe gravel ftones, and owe their beauty to the great purity of their materials, and the manner in which they have been found. The external furface is rough and unpromifing; but when broken up, they have a different appearance, fhewing an exceeding fmooth furface, with colours and veins, from an admixture of other earth with the flinty. There is always a central piece, around

which there are a number of layers, which are diverſified in all the whitiſh or milky pebbles. Theſe layers are leſs tranſparent. This is particularly the caſe with regard to the ſtones of this kind, called agates. In others there is a number of different colours, two or more in the compoſition of the layer, and which gives a greater variety to the appearance of the ſtone.

* DLXVIII.

The variety among theſe ſtones is ſo great, that there is no end in the diviſion of them. Some of them which appear like pebbles, are colourleſs and tranſparent within, and are called pebble cryſtals. In others the colouring matter is diffuſed through the whole of the ſtone; they are ſometimes of a pale red, like fleſh, as the cornelian, &c. Some have ramifications of a dark coloured matter, reſembling moſs or ſea-plants, which has been occaſioned by an opaque matter inſinuated into cracks in the ſtone, and branched out into figures, reſembling thoſe of the vegetables, as in the mocha ſtone.

DLXIX.

The free ſtone employed in building chiefly conſiſts of this flinty earth. It is plainly compoſed of ſand, cemented together by an operation of nature, as appears from the manner in which the different layers ſeparate, the ſurfaces of which are waved like the ſand on the ſea ſhore; ſo we cannot doubt but that waving has been produced by the action of water, and we meet with the relicts of the productions of the ſea, as of madrepores, &c. The ſtones are of very various hardneſs; in ſome the particles have little more coheſion than ſand, in others the grains are ſo much compacted as to look like a ſolid

flint, and they can be wrought like free ftone, which requires to be of a moderate degree of hardnefs, that it may be cut without much difficulty, and at the fame time that it may be capable of bearing the attack of the air, without being eafily decayed.

DLXX.

In England, &c. there are ftrata that contain fand and gravel both cemented together; and in the pudding ftone, which is compofed of a whitifh fand, intermixed with pebbles, fo compact is its ftructure, that it receives a fine polifh, and looks like the fkin of a fpotted animal.

DLXXI.

The flinty earth is that principal ingredient in the granite, and in the more compound rock called whin, which is a coarfer kind of granite, containing a very large quantity of iron. Granite appears to be formed like free ftone, and a great many of the grains compofing it are of the flinty kind. Upon the whole, therefore, there are not many ftony or rocky ftrata that do not contain more or lefs of this flinty earth; but befides, it is found in veins filling up perpendicular fiffures, and is called quartz, of the colour of milk and water, occurring fometimes more tranfparent, and fometimes more white, and in it there are innumerable flaws; fo the broken furface is always very rough and uneven. It occurs fometimes of a foliated ftructure, like fpar, and breaks in rhomboidal pieces, and is a mixture of fpar and quartz.

DLXXII.

The filex, or gun flint, is found intermixed with ftrata of other matter. It is fometimes found in veins, but the

greateſt quantity of it is found in the ſtrata of chalk, with which it is intermixed in very various ways, often filling up perpendicular rents; but beſides it is interſperſed with nodules that are connected together in a horizontal direction. The form of theſe is quite irregular; ſometimes roundiſh, ſometimes oblong, in a manner that is incapable of deſcription.

DLXXIII.

There is another appearance which often occurs in the ſtrata of lime-ſtone, and is then called chirt. It is met with like flint in chalk, through the lime-ſtone, and a part of the lime-ſtone ſeems to be converted into flinty matter by ſome operation of nature, and we find the relicts of marine productions in the middle of it, with which the lime-ſtones abound. Some of theſe appearances occur too in the maſſes of flint in the chalk, which ſeems to have been penetrated by ſome matter that has produced this change upon it.

DLXXIV.

But among the moſt curious forms in which the flinty earths appear, are the cryſtals. Theſe are always found in the cavities of the veins, where quartz occurs. They are either columns of ſix ſides, terminating by a pyramid, or they are found ſeparated from the ſurface of the cavity, and pyramidical at both ends; but more commonly there is not any particular column, but merely a pyramid, ſtill conſiſting of ſix ſides, and thick ſet by one another.

DLXXV.

Theſe cryſtals vary too in their colour; ſome are tranſ-

parent and colourless, as the German cryſtals; many have a dark opacity, which make them appear quite black till they are broken in many pieces, when they appear tranſparent, and in many caſes the colour can be put away by heat, by expoſing the cryſtal to a fire, or by ſurrounding it with oil; only, if the heat is too great, cracks and flaws are occaſioned. They paſs for gems; their hardneſs is nearly equal to that of the gems, and their colour is fully equal; they have their beauty, receive a fine poliſh, and wear ſufficiently. Some have a beautiful purple colour, and paſs for the amethyſt; ſome are of a yellow colour, and then they paſs for the topaz, &c.

DLXXVI.

To the ſame head may, with propriety, be referred the gems, which are found either in the ſtate of cryſtals, or pebbles, and ſeem to be compoſed of flinty matter, appearing in a much purer ſtate than ordinary; or, perhaps, in conſequence of its being improved by the admixture of ſome other matter. The colour for which many of them are admired has been imputed to metallic ſubſtances, and chemiſts had good reaſon to ſuppoſe this, as they found that the calces of metals can be made to tinge glaſs with colours reſembling theſe of the gems, but we find that the colour can be expelled by a gentle degree of heat, and this is attended with a luminous vapour around the ſtone, ſo that it depends upon a matter that is more ſubtile than the groſſer parts of the metals, as is the caſe with reſpect to the colour of the amethyſt.

DLXXVII.

The other form in which flinty earth appears, is as con-

ftituting petrefactions; we find maffes of vegetable or animal matter penetrated with it, fo as to become flinty, ftill retaining fomewhat of their original form. We have many curious examples of this in different parts of the world. And, with regard to its chemical qualities, the moft intenfe heat has never brought it into a ftate of fluidity. Some of the gems do not undergo any change from a violent heat; but, in general, the gem lofes its tranfparency, and is traverfed with innumerable flaws that render it more eafily broken in pieces.

DLXXVIII.

The next divifion we come to is the fufible earths; they poffefs this quality not exclufively, but only in the moft eminent degree. The character that may be given of them is this:—they bear a great refemblance to the flinty concretions; they are ftony hard fubftances that do not effervefce with acids, but they are not fo hard as the flinty; they do not ftrike fire with fteel, nor fcratch glafs; they fhew no great degree of fufibility, although they poffefs this quality in the higheft degree of any of the earthy fubftances; when reduced to fine powder and mixed with any of the acids, they do not emit volatile acid fteams, nor are they by means of a folution of alkaline falts changed to a calcarious earth.

DLXXIX.

The natural ftones which feem to require feparate confideration under this title are of five kinds.

The fufible earth is moft pure in what is called *flus* by the Germans, or *fluor*. They are like the more tranfparent quartz; they are commonly tinged with different colours, and have their names from the gems, as pfeudo-fmarag-

ous, &c. They are diſtinguiſhed by their great degree of fuſibility, ſo that they pervade the crucible in which they are melted: we find this ſort of earth in the rhombic quartz, which is compoſed of flinty matter. Combined with this in different proportions, it is alſo called felt-ſpat. It is found in the granites; it is compoſed of angular grains, which in moſt of the granites are cloſely compacted, ſo as to form a hard ſtone capable of receiving a fine poliſh; it occurs alſo in veins; it is a ſtone leſs trnnſparent than quartz, commonly having a reddiſh tinge, or fleſh colour; it appears to have a plated ſtructure, and it has a diſpoſition to break into rhomboidal fragments. The firſt effect of heat is to render it more brittle; if it is increaſed to a ſtrong degree the ſtone melts, or becomes paſty, and at the ſame time the rich colour commonly goes off, and it forms a ſemi-vitrified maſs of very great whiteneſs; on this account it is one of the beſt ingredients in porcelain.

DLXXX.

Another kind of ſtony matter that contains this earth is the garnate, a tranſparent ſtone of a rich red colour like crimſon; many of them are of ſuch tranſparency as to be reckoned among the gems, but the greater number are divided by flaws, and mixed with a coarſer matter, ſo they have not this colour; but when examined in ſmall particles by chemical analyſis, they are always cryſtalized into ſomewhat of an angular form. It is found to contain ſome iron, to which is imputed its red colour; ſome of them hold a quantity of tin, but there are other ſpecimens that contain none of either, and theſe have leſs colour, or are of a pale yellowiſh colour. It is found in ſeparate grains or nodules in rock ſtrata, that are chiefly compoſed

of talk. There is a confiderable tract of hills in the north of Scotland, where the little nodules of granate are contained.

DLXXXI.

Another foffil which has this earth for its bafis, is called coral, or cockle. It is a compofition of rocky ftones in feparate grains, or maffes, and cryftallized into columnar ftones; when they are of a black colour, they are called jafper, and are fometimes with fhades of green. This foffil abounds in the compofition of the ftones ufed for beautifying our ftreets, which are full of oblong cryftallizations of a fhining black colour; when expofed to heat it melts without difficulty into a black glafs.

DLXXXII.

The laft matter in which this earth is found is in the fubftance called zeolite. It occurs in nodules in rocky ftrata, and by its outfide refembles the pebbles; when they are broken they often fhew a radiated ftructure, parts of the ftone fhooting in cryftallizations from the centre to the circumference of a fphere: fometimes, when broken, they are found hollow within, and befet with cryftallizations.

DLXXXIII.

The next and laft divifion of this clafs comprehends the flexible earths. Thefe earths and ftony concretions which, when pure, are flexible, do not effervefce with acids; they do not imbibe water like the clays, nor are they fo hard as the flinty ones; in an extremely violent heat they fhew a degree of fufibility. They have been divided

into the mica and asbestine, or into the talks, or asbestus.

DLXXXIV.

The talks are foliaceous stones, slippery between the fingers, sometimes colourless and transparent, as the proper Muscovy talk. It has great transparency, flexibility, and elasticity, and is divisible into incomparably thin plates; but more commonly it is coloured; sometimes of a dark, dusty colour, and the plates are seldom so small, or so much in a plain, but waved: sometimes it has a greenish hue, sometimes a yellowish brightness, resembling that of gold, and these colours have imposed upon persons, and made them imagine they had found gold or silver, though the talk does not contain the smallest quantity of either; the yellow colour is from iron, and the silver appearance, from the particular disposition of the plates, for when they are transparent, the plates are a little separated; by heat they acquire the same silvery colour; sometimes in talk it is found forming a powdery, or earthy substance, consisting of minute small scales that are slippery, and adhesive to the fingers, giving them a colour like that of the metals. In such specimens the earth is mixed with a large proportion of metallic substances. Sometimes it occurs in a black colour, and has a shining appearance resembling that of polished steel, and abounds with iron, and it has not the flexibility of the earth in its pure state. The talk is found plentifully in the composition of many rocky strata in the granite, and other such strata as are flexible, and in rocks which contain garnets; in the stone called lapis olares, which is composed of the stealites mixed with talk, and it has a quantity of magnesian earth in its composition, and is use-

ful for kitchen utenfils that ftand the fire. There is, too, a confiderable portion of white talk in the compofition of clays and of gravel, which is all from the rubbifh of fome rocky maffes in which talk is originally formed.

DLXXXV.

The afbeftus and ameanthus differ chiefly in their ftructure from the talk, in the flexibility of the fibres, and in the clofenefs and loofenefs of their texture. Thefe are reckoned the moft pure and perfect, that may be teafed out like cotton, and can be made into a web that fuffers no harm in the fire. Pieces have been taken out of ancient Roman urns, which were ufed to wrap the bodies that were burnt, to preferve their afhes feparate; others have attempted to make a fort of incombuftible paper with it, but we cannot contrive any gelatinous matter to unite it, that will withftand the fire.

DLXXXVI.

Befides the afbeftus, properly fo called, there is a foffil of the fame nature that is formed into membranes like leather, or into maffes like flefh, or like cork, and has the names of mountain leather, mountain flefh, and mountain cork.

The afbeftus varies much in point of the finenefs of its fibres and its flexibility. In Scotland we have fome fpecimens that have fome degree of flexibility, but we have it in a ftate in which it has little, or none; in fome, the fibres are fine, and parallel to one another, and when teafed out, are like filk, or cotton; in others, the fibres are fo compacted as to form a hard ftone; but even thefe hard ftones, when long expofed to the weather, become foft like wax.

Such are, therefore, the principal ſpecimens and varieties of the earthy ſubſtances, &c. Before diſmiſſing them, we ſhall enumerate the different kinds of gems; but this title does not contain any claſs of ſtones that agree in containing any particular earthy matter, but any ſtone that has ſome colour, brightneſs, and ſmoothneſs, which pleaſe people's fancy, or taſte, is ſo called. Theſe may be divided into the precious ſtones and gems, into the marbles, jaſpers, porphery, ſtone granate, and pudding ſtone. Of the gems ſome are pellucid, others ſemi pellucid.

DLXXXVII.

The marbles are calcarious earths; they may be uſed as ſuch for lime-ſtone: ſome of them are valued in conſequence of their being of an uniform colour, as the white and black marble; but the greater number is variegated, and theſe variations depend upon two circumſtances, either upon the relict of ſhells appearing ſtill in the marble, giving it a diverſity of colour, or upon the calcarious ſtone having been ſhivered into pieces, and the interſtices filled up with other matter.

DLXXXVIII.

With regard to the jaſpers, this name is applied two ways; the artiſts make one application, and the naturaliſts another. The firſt apply it to any hard ſtone that is capable of a fine poliſh, and is diverſified with a variety of colours which are brighter than thoſe in any of the marbles, and at the ſame time they contain a harder matter; often a quantity of flint intermixed. It is, in reality, a marble, though there is here and there a maſs of flinty matter intermixed, as occurs in all calcarious ſtones, only the co-

lours are much brighter, with a large admixture of red, yellow, and white.

In natural hiſtory the term jaſper is applied to flinty ſtones that are coloured with iron, and the moſt noted of this kind is of a rich and deep green colour with red ſpots, as the heleotropium, in which the whole colour proceeds from iron. There are a great many other ſtones of this kind; moſt of them are of a reddiſh colour, as the lapis lazuli, which has been ſhewn to be tinctured with iron, and not with copper.

DLXXXIX.

The porphery reſembles marble, but is harder; it is of a chocolate colour, with white ſpots intermixed; there are many ſpecimens of it in Italy; probably brought over from Egypt.

DXC.

The granate has the felt ſpat, or rhombic quartz for its baſis, with a quantity of talk, ſo united as to form a hard ſtone receiving a fine poliſh, and is valued on account of the variety in the reflexion of light that it gives, and for the different colours of the felt-ſpat.

The pudding-ſtone conſiſts of ſand and pebbles cemented together, forming a hard ſubſtance that receives a fine poliſh, and with ſpots like the ſkins of ſpotted animals.

DXCI.

Theſe earths that have been conſidered as gems, are the pebbles, which are ſemi-pellucid, the agate, onyx, opal, chalcedony, cornelian, and mocha ſtone.

DXCII.

The agate has a whitiſh, or milky, appearance, with a more tranſparent flinty ſubſtance, and the milky appearance is diffuſed in clouds. In the onyx this ſubſtance is arranged in layers that are parallel.

DXCIII.

In the chalcedony there is a whiteneſs in an unequal manner. In the cornelian there is a reddiſh tinge, reſembling the colour of fleſh; and the mocha ſtone is an agate, with ramifications of a brown metallic matter, ſpread like the branches of a tree.

DXCIV.

The pellucid gems comprehend the flinty cryſtals; Briſtol ſtone, German ſtone, &c. which are ſo tranſparent as to look very bright: the granate of a rich crimſon colour; the amethyſt tinged of a beautiful purple; the topaz, yellow; the ſapphire of a fine blue; the emerald, green. The diamond is the moſt valuable, and at the ſame time the moſt remarkable for ſome late diſcoveries, with regard to its chemical qualities. It is diſtinguiſhed alſo by its great hardneſs, far beyond that of any other ſtony ſubſtance; and this has inclined us to ſuppoſe, that it is compoſed of a more pure earthy ſubſtance. But it is not a pure earthy ſubſtance, for it is altered and improved by ſome addition of a ſubtile principle, that renders the whole a volatile maſs; for late experiments ſhew that it is very far from being a very fixed ſubſtance; ſo that it does not agree with the other earthy ſubſtances. In general, when it is expoſed to any very exceſſive heat, it evaporates with a luminous vapour, or manifeſt flame; and other cir-

cumſtances of the experiment have ſhewn that it undergoes actually a ſort of inflammation; for unleſs the air be admitted, it does not undergo any change when it is put into a cloſe veſſel, with powdered charcoal; it withſtands any heat without the leaſt change; ſo it is only when expoſed to the air and heat at the ſame time, that it is diſpoſed to evaporate and burn away, till a very ſmall quantity only remains behind; the nature of it, therefore, is very ſingular and well worthy of further inveſtigation.

Having finiſhed the hiſtory of the earthy ſubſtances, it remains to mention the conſequence of violent heat upon them, and of mixing them with one another, and with ſome other bodies under the action of a violent heat. Theſe deſerve our attention, as from them has ariſen the elegant art of making porcelain, or the finer kinds of pottery.

DXCV.

Porcelain.

Mr. Pott, of Berlin, has made a variety of experiments upon the different kinds of earth; into which he was led by a deſire of diſcovering the compound of the true porcelain, which he publiſhed in his Lithageonoſia. They are ſo diverſified, that a general view of them can only be given. He mixed them with ſalts, with ſome of the metallic calces, and with one another, and expoſed them to the moſt violent heat he could command, by means of fuel in a furnace conſtructed for that purpoſe. The general reſult with regard to the earths of the purer kind is, that they all turned out difficult of fuſion, or rather perfectly unfuſible; but later experiments have ſhewn, that there are ſeveral of the purer earths that are capable of a very perfect fuſion, and his furnace ſeems not to have been con-

ſtructed upon the beſt principles, that the vent was too narrow.

DXCVI.

Moſt of the talky claſs, and all the claſſes called fuſible, though requiring a very violent heat, are fuſible by themſelves: gypſum, too, is fuſible, on account of the ſaline matter it contains.

But though he imagined them infuſible in their ſeparate ſtate, he found them all fuſible by means of proper additions; the moſt powerful ſubſtance for this purpoſe was fixed alkali, borax, and the calces of ſome of the metals, or a certain quantity of the fixed alkali added to the flinty earth in powder, brought it into a ſtate of fuſion, and a little more of it added makes it very tranſparent: the abſorbent earths, the gypſum, the ſteatites and clay are eaſily brought into fuſion, by means of borax; the calces of the metals of iron, and more eſpecially of lead, proved a ſolvent of all the earthy ſubſtances, except the abſorbent, though the lead in its metallic form has not the power of diſſolving the earthy bodies. Upon examining the earths, he found that the calcarious and abſorbent earths proved a means of bringing the flinty and argillaceous earths into fuſion; the calcarious earths, or gypſum, or, ſtill more readily, the fluor ſpatoſus, which contains the calcarious earth with the ſpar, proves powerful in bringing theſe parts into fuſion, and theſe mixed together in certain proportions, produce mixtures that have ſtill more power, and are capable of melting large proportions of other matters. We find ſome of theſe ſo fuſible as to diſſolve the bottom of the crucible. The knowledge of theſe particulars is neceſſary in extracting the metals

from their ores, for fome of them are intermixed with fuch a quantity of earthy and ftony fubftances, that it is difficult to feparate them.

DXCVII.

Elutriation is ufed for that purpofe; the whole matter is pounded and fet in motion in water, to fet the lighter parts afloat, and the metallic part remains behind; but in fome cafes they are fo blended that they cannot be feparated without great lofs; the only expedient is to melt the whole, when the metallic matter fettles to the bottom, and the earthy bodies float above, forming a glaffy fluid that is incapable of mixing with the metals in their metallic ftate. But there are many of the earthy matters thus blended which can hardly be melted; and the metallurgifts had been in the practice of mixing earthy and ftony fubftances together, brought from diftant parts, to obtain compounds of eafy fufibility. Thefe compounds they had difcovered, and Mr. Pott has experienced the nature of them, that the materials are always of the calcarious kind, and thefe, when added to the flinty matter, or quartz, the attendant of ores, greatly promote their fufibility.

Mr. Pott has pointed out thefe advantages that has refulted from his experiments, but he is filent upon the fubject of porcelain; and all the information we have of this fubject is from other quarters.

DXCVIII.

The porcelain brought from China and Japan has been long admired on account of its beauty, but it was

more admired than any hopes formed of our being able to imitate it. We attempted some which had a considerable share of beauty, but it was inferior to the true porcelain. Clay is the foundation of these arts, on account of its plastic nature, and the degree of hardness and firmness it can be made to assume; but it forms vessels that have neither beauty, that never burn very white, and which are apt to break and divide when suddenly heated. The addition that was found best to give them beauty was a large proportion of flinty matter, and this is the composition of the stone ware. To this, besides its strength and durability, and considerable share of whiteness, the manufacturers discovered an easy way of giving it a sort of glaze, to render it very durable; this was put upon it by throwing it into the furnace, when the heat was raised to the highest degree, viz. a quantity of common salt, the steams of which diffusing themselves through the whole cavity, penetrates all the cases in which the ware is contained, and applying themselves to the surface of the ware, brings a small portion of it into a state of fusion, so as to produce a glazing upon the outside, but still there is a number of little pits left which the matter had not covered, and which gave a a ledgment for foulness and dirt, that could never be taken out again. Of late this sort of ware has been improved, in some degree, by a sort of glazing, which takes away all these inequalities, though it does not give a colour to be compared to that of porcelain. It is a composition of materials that serve to make glass, mixed up in a thin fluid of the consistence of cream, and laid upon the surface of the ware; and this, by means of a new heat, is

diffused over the ware, and gives it always more or less of a greenish or yellow colour, which is not disagreeable, as it is diffused uniformly over the surface, though the other had this advantage, that one fire served to melt the glazing and bake the ware.

DXCIX.

But still the most perfect ware of this kind is far inferior to the China or Japan porcelain, with respect to its dilute and durable glazing, and the lively colours it is capable of receiving on account of the whiteness of its ground. Some imperfect attempts have been made in Europe very early to imitate this porcelain, but they were very imperfect till we came to receive some accounts of its manufacture from some of the Jesuits' missionaries.

DC.

These different publications have engaged a great number of persons in the pursuit of this art; and the consequence is, that they have made a great many discoveries with regard to it, and have put in practice many different ways of making ware that more or less resembles it. The greatest number have gone upon Reaumeur's principles, making use of glass for their cementing ingredients, that such compositions deserve only the name of false porcelain; they are attended with many imperfections; the difficulty of giving them the proper degree of fire: wherever glass enters it must be heated to a certain degree, to make this matter cement the other materials to a certain degree of closeness: thus the pieces lose their form and become perfectly fluid, so as to collapse in

the cafes in which they were burnt; it is alfo very nice in thefe large furnaces to give the fame degree of heat, but fome of the ware gets too little and others too much heat, and thus a great part of the labour of the workmen may be loft. But though they fucceed, the ware is attended with imperfections: it does not bear fudden alterations of heat and cold like the true porcelain. It is certain, however, that in many different places, the proper ingredients have been difcovered, and they have produced a porcelain fully equal to the Chinefe. The firft of thefe manufactures was eftablifhed in Saxony, which has been long famous for its beauty, and the expence beftowed on its decorations; but it is as remarkable for the goodnefs of its materials, having all the qualities of the beft china porcelain; the ftructure is fomewhat different, owing to a little more pains in the manufacture. When a piece of it is broken the furface of it is much finer and clofer, from the more perfect mixture of the materials.

Some difcoveries were made in France, which led to the principles upon which the true porcelain is made; and fpecimens have been prefented to the academy that have all the qualities of the foreign porcelain. In England, though feveral manufactures have been eftablifhed upon wrong principles, it is certain that there are fome, at prefent going on, that produce porcelain of the very beft quality.

DCI.

The ingredients are now perfectly known; and the principal and moft important materials are, that matter the Chinefe call petuntfe, and the ingredient moft neceffary in its compofition is the felt fpat, or rhombic quartz.

This ſubſtance, expoſed to a certain degree of heat, becomes more brittle, and when calcined to a certain degree, it is eaſily reducible to a fine powder which, in a violent heat, undergoes a perfect fuſion like glaſs; at the ſame time any colour that it had before entirely flies off, and it acquires a beautiful whiteneſs. This matter mixed in a certain proportion with a very pure clay, eſpecially containing a conſiderable proportion of white mica, or talk, forms the fineſt porcelain, and enables it to endure a violent heat without fuſion, while the other ſubſtances give it the compactneſs of texture, and ſemi-tranſparency that is admired in this ware.

DCII.

Still, however, the art is very difficult, for the materials for producing it are very rare: the felt ſpat is by no means a rare ſubſtance, but it is generally in the compoſition of the granite, which contains ſeveral other ingredients. It is compoſed of felt ſpat, quartz, and talk, and often a quantity of iron, and the ſmalleſt proportion of the metal ſpoils the whiteneſs of the matter, ſo it is difficult to find materials of proper purity; and the only circumſtance that has given the Chineſe ſuch advantage over us, and eſtabliſhed this manufacture among them ſo very early, is the plenty they have of ſuch materials; theſe materials, however, have been found. The Saxon porcelain, no doubt, depends upon a diſcovery of this kind; and the French chemiſts underſtand this ſo well, that the ſpecimens of good porcelain, produced in France, muſt have gone upon the ſame principles.

DCIII.

In Cornwall they have met with materials for the pur-

poſe, and a manufacture is eſtabliſhed there that is likely to prove a very thriving one; the granate abounds there, and conſiſts chiefly of felt ſpat and rhombic quartz, with white talk, which has been found an advantege, and they find a clay that anſwers the deſcription of the Chineſe kaolin, which is of great whiteneſs, forms a tough and ductile paſte, and has beſides another quality of the Chineſe kaolin; it is very full of white talky particles, which undergo ſome change ſimilar to that of the petuntſe, ſo it does no harm in the compoſition of porcelain. This clay is a product of the ſame ſtone with the petuntſe, which, by expoſure to the air, has undergone a ſort of decompoſition, and loſt the principle upon which its flexibility depends; and this matter, after it has been gradually waſhed off by the rain, is carried down by the water, and depoſited in particular places. When it is expoſed to a violent heat by itſelf, it bakes into a very hard ſubſtance, which has the grain of porcelain, but wants the tranſparency, and is called ſtone china, and it reſembles ſome of the Japan china, which is admired on account of its beautiful glazing and bright colour, while the Chineſe porcelain, from an admixture, is, in ſome meaſure, tranſparent.

DCIV.

By Reaumeur's diſcoveries, glaſs has been reduced to a ſort of porcelain, by taking away part of its vitrifying ingredient, the alkaline ſalt; and he got it in ſeveral reſpects to anſwer the very beſt porcelain: ſo this might be a uſeful art in making chemical veſſels; but no perſon has ever found his advantage in the eſtabliſhment of it.

DCV.

The divifion of earths now exhibited is chiefly as they are prefented in nature, or in a compound ftate. This divifion, therefore, is incompatible with the views of chemiftry, which endeavours to afcertain, with precifion, their radical principles, and on thofe principles alone to arrange them.

DCVI.

According to the defcription of this clafs formerly given, (VIII.) every earth is to be confidered as an inodorous, dry, hard, brittle, inflammable body, naturally white, and generally taftelefs: correfponding to this definition, earths have been arranged into no lefs than 10 radical fpecies.

DCVII.

The firft of them is lime, which when freed by ftrong heat from extraneous matters, is white, moderately hard and brittle, and its fpecific gravity 2.3. It yields a hot, burning tafte, is cauftic to animal fubftances, and changes the fyrup of violets green. It is not fufed by the moft intenfe heat.

DCVIII.

Lime is foluble in water but in fmall proportion, as in a temperature of 60 it diffolves only $\frac{1}{760}$ part of its weight; but at a heat of 212, it diffolves double the quantity; it combines with all the acids, and in confequence of this, various productions arife.

Sulphat of lime felenite, or gypfum, is found abundant in nature; it is of a white colour, and, by fire, is reduced to plaifter of Paris. It poffeffes a ftrong attraction for

water, which it greedily abſorbs, and in this ſtate forms mortar. It conſiſts of 32 parts of lime, 46 of acid, and 22 of water.

Nitrat of lime very much accompanies nitrat of potaſh. It is of a ſharp bitter taſte, is ſoluble in 8 parts of cold water, and has double its weight, at leaſt. It contains 22 parts of lime, 43 of acid, and 35 of water. After being heated, it ſhines with a phoſphoric light in the dark.

Muriat of lime abounds in nature along with muriat of ſoda, and its preſence gives a bitter taſte to ſea water. To make it pure, muriatic acid ſhould be clearly ſaturated with lime. It is ſoluble in 1½ parts of cold water, and in equal parts of hot water, or 212. Its proportions are 44 parts of lime, 31 of acid, and 25 of water.

Borate of lime is inſoluble in water; it cuts glaſs, and ſtrikes fire with flint; in other reſpects it is little known.

The fluat of lime, or fleur ſpat, is abundantly diſperſed throughout the mineral kingdom; it is of a compact ſparry texture, is very inſoluble in water, and phoſphoreſcent with a moderate heat. Its proportions are 57 parts of lime, 16 of acid, and 27 of water.

Carbonate of lime, or mild calcareous earth, exiſts in the different ſpecies already noticed of chalk, marble, limeſtone, calcareous ſpar, ſtalactite, &c. Its proportions are 55 parts of lime, 34 of acid, and 11 of water. By heat the acid is diſengaged, pure lime remains, which by expoſure to the air, moulders down, but again recovers its hardneſs, by a new abſorption of carbonic acid.

Phoſphate of lime is only ſoluble when the ſalt is in exceſs. Its proportions are 55 parts of lime to 45 of

phoſphoric acid. It forms the baſis of the bones and hard parts of animals.

Sulphuret of lime. Lime combines with ſulphur, either by fuſion, or by boiling them in water; and a ſulphuret thus formed differs nothing from that with the alkalies.

Phoſphuret of lime is alſo found by a ſimilar combination with phoſphorus.

DCIX.

The 2d ſpecies into which the earths have been arranged, is magneſia. When pure, it is very light and white, in the form of a ſpongy powder, and it changes ſyrup of violets ſlightly green; its taſte is alſo ſlightly bitter, and its ſpecific gravity 2.330. The combinations of magneſia are numerous, with the acids.

DCX.

Sulphat of magneſia is found native, but chiefly in mineral waters; it is then termed Epſom ſalts: but is uſually prepared, at preſent, from the liquor remaining after the extraction of muriat of ſoda from ſea water. The proportions are 24 parts of acid, 19 of magneſia, and 57 of water.

Nitrat of magneſia is found in nitre beds, along with other neutral ſalts; but it may be prepared by the direct combination of its principles: its chryſtals are of a ſharp bitter taſte; it is deliqueſcent and ſoluble in its weight of cold water, and in half its weight of hot. Its proportions are 22 parts of magneſia, 46 of acid, and 22 of water.

Muriat of magneſia is found in ſea water, ſalt ſprings, and in mineral waters; it poſſeſſes a bitter nauſeous taſte, and is very ſoluble in water. In its dry ſtate, its propor-

tions consist of 310.7 of earth, 34,59 acid, and 34.34 water.

Fluat and borat of magnesia are scarcely known, and applied to no use.

Carbonate of magnesia is prepared by mixing equal weights of sulphat of magnesia and carbonat of potash, by dissolving these salts in twice their weight of water. By boiling this solution, the carbonat of magnesia is precipitated in the form of a light white powder, which is afterward dried by a gentle heat, being white, insipid, and possessing a specific gravity not more than 23,3. It is only soluble in water, in the proportion of several grains to an ounce. Its proportions are of magnesia 0,40, of acid 0,48, of water 0,12. By calcination this salt loses its water and acid, becoming pure, or calcined magnesia.

Sulphuret of magnesia is formed by digesting equal parts of sulphur and magnesia in water; it is decomposed both by acids and alkalis, and does not unite with phosphorus or carbon.

Phosphat of magnesia is a combination little known; it is difficult of solution, and is only rendered so by an excess of acid.

DCXI.

The third division of earths is into alumen, or argil, being the base of argillaceous earth, or common clay; it is perfectly white, insipid, and light; is smooth, of an unctuous feel, and adheres to the tongue; it is diffusible in water, but not more soluble than magnesia. Its specific gravity is about 23; it combines with all the acids. The first of its combinations is sulphat of argil, or the common alum of commerce; though native, it is more commonly

produced by art, or the direct combination of its principles. Applied to the tongue, this falt gives a tafte, at firft fweetifh, but afterward ftrongly aftringent. It poffeffes frequently an excefs of acid, as appears by reddening blue paper. It is foluble in 15 parts of cold, and 2 parts of boiling water. Its proportions are 38 parts of acid, 18 of earth, and 44 of water. This falt is remarkable for forming the pyrophorus of Homberg; it is made by mixing intimately 5 parts of burnt allum and 1 of charcoal, or by melting together over a fire, till it becomes blackifh, 3 parts of allum, and 1 of fugar, of honey, or of flour, which is put in an earthen bottle about two-thirds full, and kept in a red heat furrounded with fand in a crucible, fo long as a blue flame is perceived at the mouth of the bottle. It then forms pyrophorus, and burns on expofure to moifture.

Nitrat of argil poffeffes an aftringent tafte, and is deliquefcent: by ftrong heat its acid is expelled and decompofed.

Muriat of alumen poffeffes a ftyptic faline tafte; it firft reddens fyrup of violets, and converts the colour to a green. It is decompofable by lime water, alkalis, and magnefia; its other properties are unknown.

The borat and fluat of alumen have neither yet been particularly examined.

Carbonat of alumen is alfo but little known; it has been found native in fome places, but it varies in its proportions.

Befides thefe compounds, argil has the property of combining with the fixed alkalis, and alfo with lime and filiceous earth.

DCXII.

The fourth fpecies of earth, filica, exifts in the form of a light white powder, infipid, rough and harfh to the feel, and foluble in fmall quantity in water, but not acted on by any of the acids but the fluoric, unlefs in fufion, when it combines with two, the boracic and phofphoric. Its principal combinations are with the fixed alkalies, and with them it forms glafs; it is alfo found in waters in a ftate of folution.

DCXIII.

The fifth divifion of earths is baryt, or ponderous earth, fo termed from its fpecific gravity. When found pure it is more cauftic than lime, and abforbs water, eagerly forming a tenacious cement. Its folution in water takes place with a hiffing noife. Cold water diffolves $\frac{1}{25}$ of its weight, and boiling water $\frac{1}{2}$. This earth is confidered as dreadfully poifonous.

Sulphate of baryt is lefs foluble than fulphate of lime. It is known under the name of the Bolognian ftone, and, when heated, it forms the Bolognian phofphorus. The proportions of this falt are 30 parts of acid, 67 of baryt, and 3 of water.

Nitrate of baryt is not found native. It is difficultly foluble in water. To alcohol it gives the property of burning with a whitifh yellow flame. It poffeffes a pungent cauftic tafte. Its proportions are 57 parts of earth, 32 of acid, ard 11 of water.

Muriate of baryt does not exift native. It is prepared by adding muriatic acid to the product of the decompofition of the fulphat of charcoal, or carbonat of potafh, or foda. Its folution is filtered, and by evaporation cryftal

lized. It is ſoluble in 6 parts of cold, or in leſs boiling, water. Its ſolution poſſeſſes a harſh ſtyptic taſte. Its proportions are 64 parts of earth, 20 of acid, and 16 of water.

Carbonate of baryt has no taſte, is not altered by the air, and is almoſt inſoluble in water. Its proportions are 0 86 pure baryt, 0.20 acid.

The combinations of Baryt with the other acids are of little importance, as they are applied to no uſe

Baryt alſo combines with ſulphur, phoſphoru , and ſeveral of the earths; but their combinations, as yet, claim little attention.

DCXIV.

The ſixth diviſion of earths, or ſtrontia, has not been found pure, but in combination with the carbonic acid. In many reſpects it reſembles baryt, but in others it differs. It poſſeſſes a ſharp cauſtic taſte. It is ſoluble in 100 parts of cold water, but in leſs of hot, and its ſolution cryſtallizes, changing the colour of vegetables to a green.

The different combinations of ſtrontia it is needleſs to enumerate, as they have not been applied to any particular uſe.

DCXV.

The ſeventh diviſion of earth, jargonia, or zircon, is found in a gem brought from the iſland of Ceylon. When obtained pure, it is in the form of a white powder, rough to the touch, and inſipid, having a ſpecific gravity equal to 4 300. It is inſoluble in water, forming a gelatinous maſs, that becomes hard and ſeems tranſparent. By an intenſe heat it is vitrified, and with borax forms a tranſparent colourleſs glaſs. It combines with the acids, and the alkalies decompoſe its ſalts.

DCXVI.

The eighth ſpecies of earth is glucine, diſcovered in the beryl and the emerald. It is white, light, ſoft to the touch, inſipid, and adheres to the tongue. It is inſoluble in watrr, and is by itſelf infuſible in fire. It is ſoluble in the acids, and the combinations it forms poſleſs all a ſweetiſh taſte, from which it derives its name, and which diſtinguiſhes it from every other earth.

DCXVII.

The ninth ſpecies of earth is Ytria, diſcovered in a foſſile, named Ytterby. It is white, ſmooth, and inſipid, infuſible alone, but vitrifies with borax. It combines with the acids, and its compounds have not the taſte of thoſe which are with glucine. It has been conſidered, from its other qualities, as the link that connects the earths and metals.

DCXVIII.

The laſt ſpecies of earth is Aguſtine, diſcovered in the Saxon beryl. It is white and inſipid; when moiſtened with water, it is ſomewhat ductile, but is not ſoluble in it. By a ſtrong heat it becomes extremely hard. It combines with the acids, forming ſalts void of taſte; from which it derives it name.

DCXIX.

The earths are a claſs of bodies not ſo extenſive in their uſe in medicine as the alkalies, but they are pretty much of the ſame nature in their leading qualities, and with the acids they form alſo various compounds; of theſe compounds one in particular forms the baſe of the oſſeous parts of the animal ſyſtem, phoſphate of lime, or the combination of calcareous earth with phoſphoric acid. It is

to this combination, the ſolidity and firmneſs of the hard parts of the ſyſtem, and by it the memorial of the animal body is continued after every other part is deſtroyed and annihilated. A deficiency in the quantity of this combination carried to the oſſeous parts, conſtitutes a diſeaſe known under the name of rickets, or mallities oſſium; and though chiefly appearing in childhood, or the early ſtage of life, it has alſo, at times, manifeſted itſelf at a later period. A deſire for ſubſtances of this claſs is often implanted as an inſtinct of nature in certain affections of the ſtomach, or primæ viæ, where a ſuperabundant, or diſengaged acid prevails. Thus a ſtrong inclination for the uſe of the abſorbent earths, we find manifeſted in pregnancy, in chloroſis, and alſo in worms, and ſome other complaints of infancy; but a very formidable ſpecies of this inclination is that which prevails among the negroes, termed the earth diſeaſe, which is carried to that exceſs as to clog intirely the organs of digeſtion, and to terminate exiſtence. This diſeaſe does not proceed, as ſometimes imagined, from an inclination to deſtroy themſelves, but is the effect of a morbid ſtate of the ſyſtem, and particularly of the ſtomach, which has not been accurately inveſtigated. The earth employed by them is a particular ſpecies, which they would not ſelect in this manner were ſelf-deſtruction their aim, as any earth in quantity would have a ſimilar effect: but from the uſe of this particular earth they find a peculiar gratification, or relief, from the uneaſy ſtate, which excites the deſire for it, and by this gratification they are tempted to exceed all bounds in indulging it. This ſeems confirmed by the accounts of a late traveller, to Mr. Fourcroy, who informs us, that the Otamaquas when the Oronoquo is high, and they can get

no crocodiles (their ufual food), live for three months in the year on a fat earth, or clay, of which fome of them devour a pound and a half daily. It is a pure earth, and they only prepare it by burning and moiftening it. He further adds, they are robuft and healthy.

DCXX.

The fulphate of lime has not been applied to any ufe in medicine, neither has the nitrate, though alledged to poffefs ftrong folvent powers.

The muriate is a remedy ftrongly recommended in fcrophulous cafes by fome German phyficians, and alfo fuccefsfully ufed in this country of late: it has excited the attention of Dr. Bedoes, and was alfo formerly much praifed, from its apparent fenfible qualities, by Fourcroy. The refult of Dr. Bedoes's experience has confirmed thefe favourable prefages of its qualities; and there is no cafe of fcrophula in which he has not found it fuccefsful. Even after apparent hectic fymptoms have taken place. Menfenteric, and every formidable appearance, has fpeedily yielded to its exhibition, and it exerts the powers of a highly tonic remedy on the conftitution. Its effects on the bowels alfo are not confiderable, and it is often neceffary to ufe aperient remedies during a courfe of it. Hence it is not by any evacuation that its effects are produced.

DCXXI.

Carbonate of lime in the form of chalk is much ufed as an alkaline abforbent in the difeafes of children, particularly in cafes of dærrhœa, from an acid caufe. In moft cafes alfo of colliquative diarrhœa, where the ftomach is apt to allow the food, from imperfect digeftion, to pafs

into an acid fermentation, it is usefully combined with other remedies: as an external application it is also proposed in certain cases of ulcers, particularly where there is much serous discharge, and relaxation, without a vitiated habit producing the morbid state.

DCXXII.

The second of the earths, or magnesia, is more generally employed in medicine than the former. Its qualities are, in its pure state, that of a simple absorbent; and, from its effects in this way, it is much used in all complaints where a disengaged acid is present in the primæ viæ. These complaints are particularly frequent in childhood; in the female sex, under pregnancy; and in most cases of dyspeptic patients; so that magnesia forms a medicine of general application. It is oftener used in the form of the carbonate than in the pure state; but this should never be admitted, where used as an absorbent, particularly in dyspepsia.

DCXXIII.

The preference given to sulphate of magnesia, or Epsom salts, as a purgative, depends on its great solubility.

Nitrate of magnesia has never been employed in medicine, but its sensible qualities give indications of its possessing highly active powers, which might be exerted successfully in the animal œconomy. The same observation may be made on the muriate.

DCXXIV.

The third of the earths is alumine; and the sulphate of alumine has been much used as a powerful medicine of the astringent kind. Hence it is employed in all cases of passive discharges, and often with most certain success. As a

tonic it is alſo occaſionally had recourſe to in intermittents, after the bark has failed. It is particularly uſed externally in ſolution in inflammations of the eyes, and in other caſes where the inflammatory ſtate is kept up by relaxation. When given internally in a large doſe it proves laxative, and is frequently uſeful with this intention in cholic. The other combinations of alumine are not employed in medicine, and but little known.

DCXXV.

The fourth diviſion of earth, or the ſiliceous, affords no preparations in medicine; and of the baryte, the next diviſion, only one compound is employed, the muriate: this medicine is recommended as of very powerful efficacy in cancerous and ſcrophulous affections, and the enthuſiaſm that attended its introduction, by extending its praiſes too far, leſſened the real merit to which it is juſtly entitled as an active medicine. Every one will readily allow, who has tried it, that it may be given with great advantage in certain caſes of ulcerations, particularly in thoſe of a venereal origin, where mercury has preceded without its effecting a cure, or where the conſtitution is ſo far weakened, that the ſpecific cannot immediately be entered upon. In theſe ſituations the muriated barytes will be found to amend the health, to ſtrengthen the conſtitution, and to diſpoſe the ulcerations to heal: but, at the ſame time, though it is thus a medicine of promiſing ſucceſs, it is often rendered uncertain, by being improperly prepared. From its nauſeating effect alſo on the ſtomach it is, at times, a medicine not agreeable to the patient, and with the irritable and nervous it is apt to occaſion deliquia and other troubleſome ſymptoms. It is, therefore, a

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preparation on which no great confidence can be placed for a permanent cure of any diſeaſe, though it will produce, at times, a moſt favourable commencement of amendment. The cauſe of this we muſt ſeek for in the ſtate of the animal fluids, and were we acquainted ſufficiently with the proportions of the compound ſalts exiſting in them, we ſhould then be able to regulate the exhibition of the barytes and every other ſaline remedy, in ſuch a manner as to procure, inſtead of temporary relief, a certain and permanent removal of the morbid ſtate, by clearly underſtanding its cauſe.

DCXXVI.

This ſubject of the combination of the alkaline earths with different acids, as medicines, deſerves much attention: we find that even ſubſtances apparently agreeing in their ſimple ſtate, differ materially in their combinations. Thus the baryt and ſtrontia much reſemble each other: the combinations of the former are dangerous to the animal frame, and often prove highly deleterious, while the compounds of ſtrontia may be ſafely tried, and do not appear to poſſeſs any quality injurious.

DCXXVII.

On the whole, the earths, as medicines, are very circumſcribed in their application, and it is only theſe that have received the appellation of the ſalino terreſtrial ſubſtances that have been introduced for this purpoſe.

DCXXVIII.

The firſt of the earths, or lime, has been eſteemed as a powerful lithontriptic; and lime water, in this view, has employed the pens of the firſt writers.

It gave occaſion to a diſpute between two profeſſors of Edinburgh, Dr. Alſtone and Dr. Whyte. The former alledged, that the water made from the lime of ſhell-fiſh was better than any other; and ga•e directions to add 10 or 12 times its weight of water to the lime; and when we want to make it very ſtrong, to pour the water ſeveral times upon the ſame proportion of freſh lime. Dr. Alſtone again maintained, that the lime of ſhell-fiſh was not better than the other more common kind; and that, if it was properly prepared, and the lime agitated through the liquor, it would, at firſt, be made as ſtrong as it was poſſible to make it, and that much leſs lime than he directed, was ſufficient for the purpoſe, the lime containing a much greater proportion of ſoluble matter than he imagined; ſo that it was unneceſſary to pour the lime-water repeatedly upon freſh lime, as the lime firſt added contained more ſoluble matter than the water could receive.

The quantity of the limy matter which the water contains is very ſmall; whatever pains we take to ſaturate it, not above 1 gr. in the ounce, or 16 grs. in the pound.

The combination of lime and alkalies ſhows a high degree of acrimony, with regard to animal and vegetable ſubſtances; applied to the ſofter parts of animal ſubſtances it very quickly diſſolves them; and applied to any part of a living animal, it deſtroys the part with an intenſe burning pain, ſimilar to that produced by a burning coal; ſo it is uſed for making ulcers, or iſſues, in the ſkin, and is called the potential cautery, or cauſticum commune, and it is not to be taken internally, unleſs diluted.

DCXXIX.

Sulphate of magnefia, or Epfom falt, already noticed, has been long in ufe in medicine, under the name of the bitter purging falt. It was firft obtained from the mineral purging waters at Epfom, and fold at a high price, from the fmall quantity obtained from the Epfom waters; but it was found to exift in all falt waters, in the bittern, and was prepared at Lymington, in Hampfhire, and exported to Germany, where it was much valued, ftill retaining the name of Epfom falt. It confifts of dry fmall chryftals, bearing fome refemblance to thofe of Glauber's falt, but they are more bitter and difagreeable; they contain a large quantity of water, and undergo the watery fufion. As they differ in being a compofition of an acid with an earth, inftead of an alkali in the folution, the liquor becomes turbid, and depofits a white earth, which is what we are now fpeaking of. This being chryftallized with more care, evaporated moderately, and fet by in a large quantity; it forms cryftals of a large fize, which bear a great refemblance to thofe of Glauber's falt: fo that great quantities of it are fold under this name; and the fraud is lefs liable to be detected, as the qualities of both in medicine feem to be nearly the fame, it being rather more efficacious as a purgative; only it is liable to act with a little more violence and griping, and its tafte is more difagreeable. It is very eafy to diftinguifh this fraud; to detect it: the look of it is confiderably different, Glauber's falt is ftill more of a whitifh colour, and has not that watery, or icy tranfparency, which the other has: but we need only diffolve a fingle cryftal, and apply a folution of alkaline falt; if it is Glauber falt it will remain tranfparent, but if it is Epfom falt it will remain muddy.

DCXXX.

Class V. *Metals.*

The metals are a clafs of fubftances that have attracted attention in all parts of the world by their luftre, and are valued as materials by which we can execute innumerable purpofes of the greateft importance in life; for,

1. In confequence of their fufibility and maleability, we are enabled to give them any form our purpofe requires.

2. From their ftrong cohefion of parts, they are the proper materials for machinery of great ftrength and long duration.

3. The different degrees of hardnefs and elafticity they poffefs, or can be made to affume, render them ufeful in many utenfils. And,

4. The compactnefs of their texture renders them ufeful for the conftruction of a variety of veffels; many of them bearing fudden alterations of heat and cold without injury. Befides this, their luftre and brightnefs make them ufeful in many of the ornamental arts.

DCXXXI.

They have been much more the object of attention than any of the other claffes of bodies, but much lefs advantage has been derived from the labours beftowed upon them, than might have been expected, for the greateft number of experiments have been made by vifionary projects of the alchemifts, whofe fole aim was to convert the cheaper metals into gold and filver; hence, the greateft number of thefe men thus employed had little education, and were ignorant of any chemical principles, fo that they

were for the moſt part incapable of making judicious experiments, or of underſtanding them when properly made; hence, they ſpeak with the greateſt pomp and admiration of the moſt trifling things, when, in reality, they had diſcovered nothing. They were, no doubt, led to the knowledge of many curious facts, but theſe they have concealed, or, if they have told them, it is in ſuch myſterious and ambiguous language, that it is diſagreeable to read their works. Without then entering into the fruitleſs toil of ſearching their facts, or of detecting their falſehoods, we ſhall conſider the nature of metals, as they may be ſeen and judged of, and begin with an account of their more general qualities.

DCXXXII.

The moſt obvious general quality of metals is their remarkable weight, in which they exceed all other matter. By this, they are diſtinguiſhed in their natural ſtate from the ſtony bodies, ſome of which approach, in ſome degree, to the denſity of metals, but they always fall ſhort: the heavieſt ſtony bodies only exceed the denſity, or weight of water, in the proportion of 4 to 1. But tin, which is the lighteſt of the metals, is in proportion of 7 to 1; ſo they are the denſeſt of all bodies, judging them from their ſpecific gravity. They are remarkable for a great degree of opacity, or power of reflecting the light from their ſurface, without allowing any remarkable quantity to enter their ſubſtance: all are, indeed, not perfectly opaque bodies, for we have the experience of the contrary: when they are beat into thin films, they tranſmit a quantity of light, but they may be reduced to a thinneſs ſurpaſſing that of any other matter, and yet the

light tranfmitted is very fmall; fo they are the moft opaque of all bodies.

DCXXXIII.

Metals hold the firft rank among the non-electrics; the firft of them very eafily become electrified, by being rubbed properly, and they afterwards communicate it to other bodies. They can alfo be employed to ftop the diffufion of the electrical fluids: hence, a quantity of metal is always made ufe of in an electrical apparatus, under the name of the prime conductor. It is employed to receive the electrical per fe; fo a cylinder of white iron, or pafte board with gilt paper, is made to have a communication with the globe, and as foon as the fluid is excited, it flies off to the metallic furface, which receives a quantity of it in proportion to its extent.

DCXXXIV.

No bodies in nature are more remarkably difpofed to receive the fluid than the metallic fubftances. Water is confidered as a non-electric, but it has much lefs power in attracting the electrical fluid than the metallic bodies; and a ftreamer, or ftroke of this fluid, has been communicated to every diftance with which the experiment has yet been made, without the fmalleft fenfible lofs of time; all other folid bodies, except charcoal, when perfectly dry, are capable of becoming electrical by rubbing, and may be ufed to ftop the electrical fluids; but the metals never fhow any fign of this, and the electrical fluid has the ftrongeft difpofition to fly off along the furface.

DCXXXV.

Metals affume a fluid form, by heat, in a particular manner, retain their opacity, appear as a fluid of a bright

and ſhining ſurface, reflecting, in a lively manner, the image of objects that are around, as in the drops of mercury, which is, in fact, only a melted metal, and the ſmall drops always form themſelves into little ſpheres, in conſequence of an attraction of the particles for one another, and their being repelled, in ſome meaſure, by the ſurrounding matter. And they aſſume this form not only when laid on the ſurface of ſolid bodies, but even when put into water, oils, melted earths, &c. they always form themſelves globular maſſes, which ſhow that the particles attract one another more than they do thoſe of the matter that ſurrounds them.

DCXXXVI.

To theſe may be alſo added, their malleability and ductility; though they do not all poſſeſs theſe, the greateſt number do: they are the only bodies in nature in which theſe qualities are found. By malleability, we underſtand a diſpoſition in the metal to have its form changed by hammering; and by ductility, a diſpoſition to be drawn out in fine wire.

DCXXXVII.

This is done by means of a fine plate, perforated by a number of ſmall conical holes of different ſizes, the internal ſurface of which is highly poliſhed. The metal is firſt formed into a cylinder, the extremity ſmaller than the reſt; then a ſtrong pair of forceps takes hold of the extremity, and, by means of machinery, the piece is drawn through the hole, which being narrower than the piece, is drawn out to a conſiderable length, and diminiſhed in its diameter, with the ſurface highly poliſhed; and after being paſſed through one hole, it is made to paſs through

a ſmaller hole, then through a third, till it is reduced to the fineneſs of a human hair.

DCXXXVIII.

But the metals that are capable of being drawn out into wire, are not always malleable in the ſame proportion, nor are all the metals that poſſeſs malleability ductile. Some poſſeſs both theſe qualities very remarkably, as gold, ſilver, copper, &c. Others again are capable of being beat out into pretty thin leaves, as tin, but are not capable of being drawn into wire. Lead can be beat into leaves, but not ſo thin as theſe of tin. Iron can be drawn into very fine wire, but it cannot be beat into very fine plates.

DCXXXIX.

In the treatment of the metals in ſome of theſe proceſſes, it is found that they bear only a certain degree of extenſion under the hammer, or, in ſome caſes, in being drawn out into wire, they acquire a degree of rigidity, which ſtops the further progreſs of their operation till they have been ſoftened again; this occurs in gold and ſilver more than in copper, and ſtill more remarkable is it with iron. When their form is attempted to be changed by hammering, after the metal is extended to a certain degree, it becomes rigid and hard; this is remedied by the proceſs called annealing, which is the expoſing the metal to a dull red heat, and then allowing it to cool ſlowly, when it is found to be ſoftened ſo as to bear further extenſion; and this remedy may be repeatedly employed.

DCXL.

In examining the effects of heat upon metals, we obſerve that

Each metal requires a particular degree of heat to its fusion; some the most violent degree. When melted, some of them are liable to produce violent and dangerous explosions, coming into contact with water, especially when the humidity adheres to the surface of a mould, in which a great quantity of melted matter is to be cast; for, in this case, it is applied to water very suddenly, and with an extensive surface, changing it into an elastic vapour, and producing similar effects to a quantity of gun-powder suddenly fired. This is especially remarkable in copper, which is one of those metals that require the greatest quantity of heat, to heat it to a given degree; so when it is very suddenly applied to a surface of watery humidity, it communicates a great quantity of heat, and converts it into vapour with the utmost violence.

DCXLI.

Many shew themselves volatile in a certain degree of heat: they can be totally converted into vapour, even in close vessels, though, in general, the admission of fresh air disposes them sooner to rise in vapour.

DCXLII.

The degrees of facility with which the different metals combine with oxygen vary, and even the aid of temperature at times renders it difficult to effect it. The combination, however, of two metals renders this process always easier effected than where they are in a separate state.

The quantity of oxygen also absorbed by different metals is equally various, as the circumstance of their combination; and each metal is capable of various degrees of oxy-

dation, at which various degrees different changes are produced on it, both in colour and other properties.

In all cases the attraction for the absorbed body is greatest at first, and lessens in successive degrees of its application; in some instances it is so great as to reduce the metal almost to an acid.

The effect of oxydation on the metal when exposed to intense heat, is either to reduce it to a state of fusion, or to form a glass of it; and to decompose it in part, or preserve still its oxydated state; or by the absorption of its oxygen entirely, and by means of another inflammable body, to restore it again to its metallic form.

Besides oxydation by oxygen, or atmospheric air, metals may undergo the same change by exposing them to substances already in an oxydated state, from which they attract the oxygen they possess, and thus decompose them; 2dly, metals also may be oxydated, by means of the decomposition of water, where their attraction to it is superior to hydrogen, and their decomposition is considerably aided by an increased temperature.

Metals may likewise be oxydated by acids, the nitric and oxygenated muriatic acids do it most readily; but, in order to their oxydation by acids taking place, some slight degree of this process must first have been in them; so that oxydation gives the metals an attraction for acids; this attraction for acids is lost by the metals being saturated with oxygen, and, in consequence, the metal becomes insoluble in the acid; a property it acquires only by abstraction of part of its oxygen.

DCXLII.

Metals then are inflammable substances, and these effects

of heat ſhew their ſtrong ſuſceptibility of combination: their moſt important combination is that with oxygen; for if a metal is heated to a certain temperature, either in contact with oxygen or atmoſpheric air, it loſes its diſtinguiſhing qualities deſcribed, and is converted into a ſubſtance reſembling an earth. This change conſiſts in the abſorption of oxygen, and the conſequent oxydation or calcination of the metal.

In different metals this proceſs takes place in different degrees of temperature, and with the ſame variety in its rapidity, but it is in general more rapid in oxygen than in atmoſpheric air.

DCXLIII.

The chief of inflammable ſubſtances is ſulphur; and it may be united, in the way of fuſion, very intimately with the metals. If the heat is only ſtrong enough to melt the ſulphur, it will penetrate and change the appearance of the metal. It acts with ſome appearance of violence; and there is an increaſe of heat to ſuch a degree as to ſet the maſs on fire: it appears red hot: it is alſo found to attract the different metals with different degrees of force, and one can be employed to ſeparate another, and iron to ſeparate all the reſt. This ſeparation is performed in the way of fuſion; the compound flows uppermoſt, and the other metal falls to the bottom. But this is not neceſſary in all caſes; in many, the ſulphur may be expelled by heat alone. Sulphur cannot be made to penetrate three of the metals, viz. gold, platina, and zinc; but with regard to zinc, the facts are rather doubtful, though the hepar ſulphuris diſſolves them like the reſt; we uſe equal parts of the ſulphur and alkali, which diſſolves the gold, &c. with conſiderable violence and rapidity.

DCXLIV.

In mixing metals with each other, there are ſome exceptions; thus lead and zinc ſhow an indiſpoſition to unite together; it is alſo difficult to unite iron and mercury, though the mercury does ſhow ſome power of penetrating the iron. In like manner, lead and cobalt ſhow an averſion to unite; the lead diſſolves a ſmall proportion of it, but the remainder floats on the ſurface. Cobalt, too, and Biſmuth, ſhow an indiſpoſition to unite, and nickel ſhows alſo an indiſpoſition to combine with cobalt.

DCXLV.

The mixtures produced are of different ſpecific gravities, from what we would expect from our knowledge of the metals in their ſeparate ſtate; a mixture of mercury and ſilver, for inſtance, turns out heavier than the mercury itſelf, though the ſilver is conſiderably lighter; it generally happens too, that ſuch mixtures turn out more fuſible than their component parts; hence the ſolders for uniting the maſs of metals together are generally mixtures of the ſame metal, with ſome other metallic ſubſtance. So, for gold, they uſe gold and ſilver; for ſilver they uſe ſometimes the ſame mixture, but more commonly a mixture of ſilver and copper; for copper they uſe braſs, which is a compound of copper with zinc; and, for braſs, a metal ſtill more compounded, iron, lead, and tin, being a mixture moſt uſed. It is, therefore, a pretty general rule, that the compounds of metals have more fuſibility than the medium fuſibility of their component parts; and it may be given as a general rule, that ſuch mixtures

are more difpofed to calcine, as in the mixture of tin and lead.

DCXLVI.

The manner of feparating the metals from one another is very precarious, and depends upon certain particular properties and differences of the metal we defire to feparate; thus, in fome cafes, a difference of fufibility is made the foundation of feparation; as with regard to lead and copper, which are often feparated and mixed again, in order to extract filver from copper: the manner of feparating the lead from copper is to caft the maffes like flat cakes into a furnace, where heat can be raifed, fo as make them red hot, the lead melts and runs down through a channel cut in the floor of the furnace, into a place prepared for its reception, while the copper remains unmelted in the floor of the furnace in a fpongy form; in other cafes a difference of volatility is taken advantage of. Thus, when mercury, or antimony, is mixed with other metals, we can feparate them perfectly, by converting them into vapour: thus we feparate antimony from gold.

DCXLVII.

The acids give to their metallic combinations a faline nature, by which they acquire fomewhat of the properties of compound falts, and like them, by the union of the two fubftances, a faturation takes place, fo that the acids lofe their diftinguifhing property. Such combinations are foluble in water, and are termed metallic falts. The fame nomenclature is alfo applied to them as is applied to the falts.

DCXLVIII.

In this combination the metal exiſts in different degrees of oxydation, and theſe differences are verified by their peculiar properties and appearance.

DCXLIX.

The metallic ſalts are decompoſed in three different ways:

1. By the addition of earths or alkalies to their ſolution, from the ſuperior attraction of theſe ſubſtances to the combining acid.

2. By the addition of another metal attracting the oxygen that holds the combination diſſolved; or,

3. By the addition of another acid exerting a ſtronger attraction to the oxyd than the one employed.

DCL.

Metals ſeem incapable of combination with hydrogen or azote, in any ſtate. Some combinations, however, take place with carbon, and they never fail with ſulphur, which produce the ſame effects upon them as combuſtion. The alkaline ſulphurets poſſeſs the ſame property, and phoſphorus combines alſo with the metals, and they retain with it a conſiderable ſhare of their metallic ſplendour.

DCLI.

Combinations alſo take place between the metals by means of fuſion, and ſuch compounds are termed alloys, differing in the ſpecific degree of their properties, though retaining the general one of metals.

DCLII.

No combinations are formed with the earths, except when the metals are in the form of oxyds.

DCLIII.

The metals are found in different ſtates in nature, and the ſeparation of them from their ores is a neceſſary point previous to their conſideration.

The firſt part of it is to ſeparate the ore from the great quantity of earthy and ſtony matter. When it is found in the vein in large maſſes, it may be dug up pretty clean and free of the ſpar, and theſe pieces to which the ore adheres may be freed by the hammer and chiſſel; but it oftener happens that the ore and ſpar are intermixed in ſmall maſſes, and the expedients metalurgiſts have recourſe to, is to take advantage of the difference of ſpecific gravity between the ore and ſtony matter. When they are powdered, and a ſtream of water allowed to flow over them, it ſets afloat the greateſt part of the ſtony matter before it raiſes the ore. This operation is called by the Engliſh miners elutriation; there are many different methods of managing it, which produce a very exact ſeparation of the ore from the earthy or ſtony matter.

DCLIV.

When it is ſand and ſoft clay earth, and the ore is in hard lumps, it is readily ſeparated from it by the water; or where it is mixed with a calcarious matter, the water gradually diſſolves this, and leaves only an irony ochre. But the matrix is not frequently diffuſible by water, ſo it muſt be powdered by mechanical means, and for this purpoſe they uſe milns, which are wrought by water. The matrix is ſometimes even harder than the ore of any metal, ſo the ore is reduced to a fine powder ſooneſt, and then its ſpecific gravity will not avail it. The heavieſt

fubftances, reduced to a fine powder, are not eafily fet afloat in water; but thefe fubftances may be burnt with a brifk fire; and then throwing water upon them, when red hot, they gradually are divided into innumerable cracks; or if the matrix is fparry, it is calcined into a lime, which is reduced to powder. Upon the effufion of water, at the fame time, the hafty heat melts the ore, makes the fmall metallic particles unite into round drops, which will more readily fink in water. So in this way the ore can be pulverized with fuccefs.

DCLV.

But though the ore can be feparated from great quantities of ftony matter, it cannot be done without the lofs of fome of the metal, and fometimes of a great quantity of it. So they find it neceffary, in many cafes, to procure the feparation, by bringing the whole into fufion; and this is very much practifed in Germany. The ore is mixed with the fuel, and the heat raifed by bellows, and they often mix ftones of different kinds to facilitate the fufion. If the matrix is a flinty earth, they add a quantity of the fluor fufible fpar, and a quantity of the calcarious earth, which produces a more fufible mixture. If it is totally calcarious, a fmall addition of the quartz, or of the fluor, is proper. During this fufion a part of the fulphur and arfenic, which the ore contains, is alfo diffipated, and the metallic matter is more concentrated; and if any of the more calcinable metals are intermixed, they are alfo feparated. This operation is called the crude fafhion of ores, which is only performed with large quantities of earth, capable of perfect fufion, by proper additions.

DCLVI.

When the ore is freed from all the matrix, the next set of operations are intended for separating the sulphur, or arsenic, or both. This is done by exposing the ore to the action of a gentle heat, and of the air, at the same time, before the strong fire be applied to melt the metal to a solid mass; for a violent heat occasions a loss of the metal, as these volatile substances volatilizing a portion of the metallic matter, or mixing it with the scoriæ, occasion part of the metal to be lost. So the ore is first exposed to the action of a red heat, long continued, which is called roasting. The ore is built up in heaps, with fuel intermixed, in a furnace of a particular structure; and sometimes the ores are roasted four or five times, where the metals are valuable.

DCLVII.

After this operation a great part of the metal remains in the form of a calx, or oxyd; so it requires the operation of reduction to be done, which is performed in a particular furnace, the structure of which varies according to the degree of heat, and to the fashion of the place. A considerable variety is described by ancient authors, and these in use at present differ only in being larger. They consist of a tower built with a wall, into which the nosal of a pair of bellows is introduced; in the bottom there is a bed of charcoal and clay, and towards the front of this bed there is a perforation that can be opened at pleasure, and this communicates with a cavity prepared with the same materials, where the metal is to lie till it cool, and the parts separate properly from one another.

DCLVIII.

These employed at Carron, for the melting of iron,

are incomparably larger, and ſwell out at a certain height above the fire, where the moſt intenſe heat is produced, that the ore may be heated gradually, and undergo a ſort of roaſting before it is melted. In the melting of ores in this manner, it is ſometimes neceſſary to add particular ſubſtances, to promote the fuſion of the earthy matter; or, to abſorb ſulphur or ſulphuric acid, lime is often uſed, and is a neceſſary article in the melting of iron.

DCLIX.

The ore requires ſtill another operation, viz. refinement, to ſeparate ſome other matters that are generally mixed with it. Few ores contain the metals from which they are denominated in a pure ſtate, generally two or more metals are intermixed; ſo the laſt operation is to refine the principal metal from the others. The manner of doing this, with reſpect to each particular metal, falls to be mentioned in their treatment; it depends upon the ſame operations by which the metals are ſeparated from one another. But it may be proper to obſerve, that there are many ores that do not require, or do not admit of all theſe operations, but agree with the omiſſion of ſome, and the variation of other. Thus ſome have the metal free from ſulphur and arſenic, and do not require roaſting.

DCLX.

It is proper alſo to mention here the art of eſſaying, which is a branch of the ſame operation. It is the art of performing all the operations upon ſmall quantities of the ſubſtance in a ſhort time, to judge of the nature of the ores, the manner of working them, and the profits they

will yield. It is neceſſary to the art of coining, and to the regulation of the fineneſs of bullion and plates. It requires the greateſt accuracy and attention, as a ſmall loſs would occaſion a great error in the calculation.

DCLXI.

The quantity being exceeding ſmall, the different parts of the art are, 1ſt, The choice of the ſpecimens to which the eſſayiſt muſt be attentive. The ſpecimen ſhould be ſimilar to the whole maſs; for if the ſmalleſt error be committed here, all his pains will be loſt. When it is taken from a heap of ore it is only meant to learn the nature of the ore, and what metal it contains, without any attempt to make an eſſay. But in carrying on the buſineſs of mining in Cornwall, it is divided into different kinds. One ſet of men dig up the ore, and bring it to the day, then it is dreſſed, by ſeparating the earthy and ſtony matter, when it is laid up in heaps. Other perſons examine it by an eſſay, and bid a price in proportion to what they judge it contains of metals, and to the profits it will yield on melting. So the eſſayiſt muſt be careful in taking his ſpecimens, to do which it is neceſſary to take a ſhovel full from the lower part of the heap, another from the upper part, another from the internal part, and another from the external or middle part; for the larger and heavier maſſes roll down the ſides and lie at the bottom, and different parts of it may be different. But by thus taking it from different parts, and mixing all theſe together, the quantity will be ſimilar to the whole. This is reduced to a fine powder, and all mixed together, and divided into two equal parts; one of theſe is beat into a ſtill finer powder, and mixed and divided again. One of theſe halfs is again mixed and ſubdivided

again, and thus at length a ſpecimen of two or three ounces of it is ſimilar to the whole maſs from which it was taken.

DCLXII.

In taking a ſpecimen of a metal, the fineneſs and contents of which are to be examined, we muſt take pieces from different parts of the maſs, as metals are caſt into large maſſes, in the form of bars, the lower parts of which contain different ingredients: ſometimes from the upper, and ſometimes from the lower part: ſo the eſſayiſt ſtrikes off a part from the upper part, another from the under part, another from the centre, and another from the circumference; then takes a ſmall ſpecimen of theſe.

DCLXIII.

Next his attention muſt be paid to the manner of examination of the weight, in order to judge of the products, what proportion it bears to the whole; and for this purpoſe he is provided with a balance, conſtructed with the greateſt nicety; the beam is generally ſo ſlender, that it is fully loaded with two ounces in each ſcale, and turns with the 400 part of one grain; by means of this he weighs a quantity equal to one dram. In Cornwall they uſe a larger quantity, but in Germany they have reduced that art to the greateſt nicety, and ſeldom uſe more than one dram. They have a little weight equal to that which is the mark for a hundred weight, and they have a number of other weights that bear the ſame proportion to it, that the ſubdiviſions of a hundred weight bear to it.

DCLXIV.

They first roast the specimens in the muffle of an essay furnace, in little flat dishes. For separating the sulphur and arsenic, the fusion is then performed, by adding black flux, &c. and a little metallic globule is obtained, which is made to undergo the operation of refinement; and in order to give a certain judgment, such trial requires to be repeated two or three times.

DCLXV.

From these general observations on the metals, we are next led to treat of them particularly, and they are generally divided into metals and semi-metals. These are called perfect which have a considerable degree of malleability and ductility; and these semi-metals, which want these qualities, and are brittle under the hammer, &c.

DCLXVI.

The perfect metals are divided into the more perfect or noble, and the less perfect, or baser. The more perfect are gold and silver, from their resisting the injuries of the air, and the action of the more powerful agents, which affect the others called baser metals.

In treating the metals we shall begin with the one which is most generally employed in medicine; this is mercury. It has fluidity and volatility in a greater degree than the other metals, and becomes solid and malleable, when cooled to a certain degree.

DCLXVII.

Mercury.

The chemists have particularly turned their attention to this metal, partly from alchymical views, and partly

with a view to medicine. From its greater denſity it approaches nearer to gold than any of the other metals, and it has been eſpecially an object of the pharmacetical chemiſtry ſince it was found to be a ſpecific for the venereal diſeaſe.

DCLXVIII.

In order to its application, it is neceſſary to make it undergo ſome preparation, that it be divided; for when it is thrown into the body in its crude ſtate, its effects are very uncertain, if any. It was common ſome time ago to ſwallow conſiderable quantities of it; but it ſeldom produced any ſenſible effect, except when divided a little by the action of the inteſtines. Therefore, to have the effect in proportion to the quantity, it muſt be prepared by an exquiſite diviſion of its particles from one another, by rubbing it along with viſcid and other ſubſtances, which divide and hinder the parts from joining themſelves to one another again. Long continued agitation with water will have this effect; but the diviſion of it is much more quickly obtained with the addition of axunge, turpentine, and other balſams, or of the mucilaginous viſcid ſweets, honey particularly, which is very effectual. Even earthy powders have been uſed; but theſe divide it leſs perfectly.

DCLXIX.

In conſequence of this minute diviſion, it acquires a ſmall degree of calcination, or becomes oxydated; it affects the tongue with a diſagreeable taſte, probably owing to an ammonical ſalt in our fluids, which acts upon mercury when ſubdivided with it. When thus calcined to a certain degree, it is more diſpoſed to unite with ſaline ſubſtances; and from the facility with which it is diſſolved in the animal hu

mours, there can be no doubt that ſuch a degree of calcination, or oxydation, has taken place.

DCLXX.

On its chemical qualities we obſerve, that heat ſuddenly applied makes it boil and evaporate, in a degree inferior to that which makes it red hot. If that vapour is condenſed, it returns again to the form of mercury, not undergoing that quick calcination that the vapour and other volatile metals do.

DCLXXI.

From this circumſtance mercury can be ſeparated from other metals, none of which are any thing near to it in point of volatility; and this is often neceſſary, and happens in different arts, as in the foiling of mirrors, where it is mixed with tin and lead, and it is frequent to ſophiſticate it with large quantities of lead. But it is eaſily known when mercury contains any extraneous matters, by letting a ſmall quantity of it ſtand in a vial that is dry and clean, for ſome time, and making it run from the one end to the other. If pure, it runs without leaving a train behind it; but if it contains only a ſmall quantity of other metallic matter, it fouls the glaſs, and there is ſeen on the ſurface a tough ſkin that is formed into folds and wrinkles, occaſioning a ſtain to be left behind it, when running from one end of the glaſs to the other. This appearance, however, may be occaſioned by humidity, or more readily by oil. If this is the caſe it can be eaſily purged, by draining it through leather or linen, ſqueezing it over a funnel to make it run into a dry vial, when it aſſumes the ordinary appearance of pure mercury; or, by paſſing it through a cone of paper,

with a ſmall hole in the extremity; for any foulneſs which it contains, by greaſe, will remain in the cone; while, if it contain any other metallic matter, it will, in a ſhort time, recover the ſame appearance of foulneſs; from which we know certainly that it is impure.

DCLXXII.

There is no other way of purifying mercury but by converting it into vapour in a ſmall glaſs retort and receiver. It is not neceſſary to put in water, as it is eaſily condenſed, if the heat is moderate. It is uſual to add a quantity of iron filings during this diſtillation, the effect of which is to give it the appearance of pure mercury to a greater degree than when it is diſtilled by itſelf; but at the ſame time it is attended with a quantity of greaſy matter, which the iron filings contain, from the ſmiths uſing ſo much oil. This is eaſily ſeparated by drying it on a plate before the fire, and then paſſing it through a cone of paper; after which it appears brighter than when diſtilled by itſelf.

DCLXXIII.

Mercury, thus haſtily converted into vapour, condenſes again, and it does not bear to be long expoſed to this heat, without undergoing ſome calcination. If we ſimply diſtil it three or four times, it begins to undergo a calcination very ſlowly. In the bottom of the retort there is a quantity of reddiſh powder, which is a calx or oxyd of the mercury. This has given occaſion to the contrivance of an apparatus, and a proceſs for calcining mercury. It is a veſſel in the ſhape of a mattraſs, wide at the bottom, ſometimes ſpread out very wide, and flat and contracted towards the top, with a high dome. The

bottom is covered with mercury, which is expofed to the air with a greater furface, and fet in a furnace, with a degree of heat that it can bear without being converted into vapour; only a little vapour is raifed, that will be condenfed, and fall down again. After fome weeks we can perceive fome calx or oxyd, formed into little flat maffes floating on the furface, and by continuing the fame heat, for a number of months, a greater number is formed; but it will require a year or years to convert it all into calx. The heat it bears is fo moderate, that the air has little power in calcining it.

DCLXXIV.

Thus mercury requires a ftrong heat to convert it into vapour, equal to 600 or 550. It muft be heated to a red heat; but it will arife, and may be condenfed again, forming tranfparent cryftals of a deep red colour, and which are a fimple calx or oxyd of the metal, and it may be reftored to its metallic form by expofure to heat, in contact with inflammable fubftances. This preparation is an article in the London difpenfatory. Whether the apothecaries are furnifhed with the genuine preparation is doubtful, from the long time it requires. There are druggifts in London who may have it genuine; but the mercurius calcinatus, or red oxyd of mercury, in general is fome other preparation fubftituted in its place.

This oxyd is very foluble in all the animal humours, and in all the acids.

DCLXXV.

But the greateft variety in the preparations of mercury is from the operation of acids upon it; and firft, with regard to the fulphuric acid. This acid, applied without the affiftance of heat, produces no effect: it muft be

assisted by the strongest heat that this acid can bear, and it must be in its strongest state. Thus the acid being made to boil, an effervescence is observed, the mixture assumes a brown colour, steams arise which have a strong odour of the sulphureous acid. At the same time, while the mercury is dissolved, it is gradually converted into a white saline matter. Thus combined it has little solubility; it consists of minute crystals; it is very ponderous, from the quantity of the mercury; and highly corrosive, from the quantity of acid. It cannot be decompounded by the application of heat; it requires a stronger heat to change it into vapour than either the acid or mercury alone.

DCLXXVI.

When the heat is increased, this compound arises entire, without any separation of its parts; but water added does in some degree decompound it When we put it in warm water, and agitate the mixture, the colour of the compound is changed into a bright yellow, the water separating part of the acid, and leaving the mercury in the form of a calx or oxyd, which is of a red or yellowish colour; this is called turbeth mineral, or sulphate of mercury, and it ought to be washed repeatedly, till the water comes off insipid. This preparation varies in strength according to the proportion of the oxydation, or the quantity of oxygen combined. It is decomposed by alkalies and lime, but is only partially decomposed by ammonia.

DCLXXVII.

The nitric acid acts more violently upon the mercury. By this decomposition a large quantity of nitrous gas is

discharged, the metal is oxydated, and combines with the remaining acid. The decomposition is more moderate if the acid is diluted with more than an equal part of water, and the metal is also only imperfectly oxydated. But an increase of oxydation may be completed either by strength of acid, or by a diluted acid assisted in its action by heat. The products of these oxydations are salts soluble in water, chrystallizable and extremely caustic; and the difference of their oxydation is rendered conspicuous by the addition of an alkali, particularly ammonia, which occasions the precipitate of the one to be black or grey, and of the other of a white colour. This decomposition is farther assisted by heat; for the mercury attracting more oxygen, nitrous gas is expelled, and a red mass remains, which consists of the perfect oxyd of mercury, known by the name of red nitrat of mercury.

The combinations of mercury with the nitric acid are decomposed both by the alkalies and several of the earths.

Either of the fixed alkalies, or lime added to the diluted solution of the weak acid, without heat, occasions a greyish precipitate to fall; and to the other solution with the strong acid, assisted by heat, it occasions a yellow precipate to be formed.

DCLXXVIII.

But when ammonia is employed it produces a different effect; it precipitates the mercury from the cold solution in the weak acid in the form of a grey coloured powder, containing the metal in its lowest oxydation; or it may be considered as mercury simply divided into exceeding minute parts, with no more calcination than what takes

place in the triturated preparations; and when we rub it on the surface of gold, it adheres and whitens it. This depends on the hydrogen of the ammonia attracting part of its oxygen at the moment of its separation. When the ammonia is added to the highly oxydated solution, the first quantity added precipitates it in the form of a white powder, or a grey coloured one is thrown down. In both solutions, as part of the mercury generally exists in both states of oxydation, so the addition of ammonia produces a precipitation of both kinds, and thus a grey or light blue is formed; but when, for the purposes of medicine, the mildest precipitate is preferred, an attention should be paid to the diluteness of the solution, and the absence of heat.

DCLXXIX.

The muriatic acid does not act on mercury, unless the metal be previously in a state of oxydation, and then it has a much stronger attraction for it than any other acid. We apply the acid in its pure state, or some compounds that contain it, and that may be decompounded in any heat, when we have a most intimate union, and obtain a very volatile substance, which easily rises into vapour, and can be condensed without any separation of its component parts. It is separated by sublimation, so called mercury sublimate, or muriated mercury.

DCLXXX.

The muriated mercury, or corrosive sublimate, has the form of a white salt, which is very ponderous, and being heated proves more volatile than mercury alone, and rises entire, without any separation. But the par-

ticular mode of procedure, in performing this operation, has been greatly diversified.

DCLXXXI.

The best mode of preparing the corrosive, or muriated mercury, is,—To mercury calcined, by means of the nitrous and muriatic acid, we add an equal weight of common salt, and as much vitriol from which the water has been evaporated. When this mixture is heated the acid attracts the alkali of the common salt, and detaches the muriatic acid in strong fumes, which unites with the calcined mercury, and forms the saline compound, which being volatile, immediately rises in vapours, and is condensed in the upper part of the glass; but in the beginning of the operation there is a small quantity of watery vapours, which rises from the mixture. It is impossible to mix saline substances without attracting humidity, and a small portion of the nitrous acid is expelled. So it is necessary to make some provision for the condensation of the acid steams, by applying a capital to the top of the subliming vessel, whereby the liquor runs off, while the corrosive sublimate condenses in the upper part of the glass.

DCLXXXII.

Muriated mercury forms a compound that is totally soluble in water; but when the acid is too little, a portion only dissolves; but in all cases it requires a pretty large quantity of water. We promote its solubility by adding a little of the muriatic acid, or some muriat of ammonia, or crude sal ammoniac; the muriatic acid of that compound salt acts upon the corrosive or muriated mercury, so as greatly to promote its solubility; and a quack

medicine of Ward is supposed to contain mercury combined with nitrous acid, the solubility of which is increased by its combination with an ammoniacal salt. Though this mercurial salt is used as an internal medicine largely diluted, and is found of great efficacy, and sufficiently safe, it was considered some time ago as one of the greatest poisons, and only applied externally. It was chiefly made for obtaining some other preparations, as mild muriated mercury, or the mercurius sublimatus dulcis, which is made by mixing crude mercury with the corrosive sublimate, in equal quantities. They are carefully ground together and combined, so as to form a white powder, which requires a strong heat to convert it into vapour, and it forms a more dense cake; it has less the appearance of a salt, and is considerably heavier. In this compound the oxygen of the corrosive becomes attracted by the mercury, it loses its corrosive quality, is reduced to an imperfect oxyd, and is perfectly mild. This mildness we find directions to improve by repeated sublimations; but the effects of these are doubtful.

DCLXXXIII.

The most proper method to render the mercurius dulcis mild, is to reduce it to powder, and boil it in water, when the acid is dissolved in the water, and that is the proper way of edulcorating it.

DCLXXXIV.

Though the acid cannot be separated by any of the other acids, it is separable by alkaline substances; the fixed alkali or quick lime, or ammonia, produce this effect, when to a solution of corrosive sublimate we drop in some fixed alkali; it is precipitated in the form of a

brown or orange coloured powder. Lime water precipitates it much in the same manner, when a certain quantity is added, but the colour is not so deep; it is changed into a yellow precipitate, like turbeth mineral. Ammonia precipitates the mercury in the form of an exceeding white powder.

DCLXXXV.

This precipitate from the ammonia is one of the white precipitates in the London dispensatory. It is produced by a process by which the same thing is brought about: by dissolving in water, the muriated mercury, or corrosive sublimate, and crude sal ammoniac, or muriat of ammonia, and adding a fixed alkali. But in chemical authors there is another white precipitate of mercury which cannot be distinguished from this. It is produced by adding to the diluted solution of mercury in the nitrous acid some common salt, while the acid of the common salt attracts the mercury, and the compound being less soluble in water, it falls to the bottom in the form of a powder, or of small crystals forming a white sediment, which is called white precipitate of Dr. Boerhaave. But it is a corrosive sublimate, only not completely oxydated, or containing such a large quantity of acid as when obtained in the way of sublimation, but it is totally soluble in a sufficient quantity of water.

DCLXXXVI.

The alkalies, or lime, precipitate from the mild muriated mercury a greyish precipitate. When ammonia is added, it is black, and partly deoxydated.

DCLXXXVII.

Such are the principal forms which mercury has been

made commonly to aſſume by means of ſalts; but there are methods of combining it alſo with other ſaline ſubſtances. The fixed alkali, in ſome caſes, is made to diſſolve it, and the vegetable acids are eaſily combined with it; but when calcined by heat and air, or oxydated by other acids, they diſſolve it more perfectly, as vinegar or tartar; and Keyſer's pill contains a mercury prepared in this way.

DCLXXXVIII.

From this view of the effects of the ſaline bodies upon mercury, it puts on a variety of ſhapes, as of a red, yellow, white, or other powder; ſometimes of tranſparent fluids, according to its degree of oxydation from the acid. From theſe combinations it may be ſeparated again, by mixing ſuch preparations with an equal weight of iron filings or fixed alkali.

DCLXXXIX.

The dried oxyds precipitated by ammonia or lime, and triturated with $\frac{1}{6}$ their weight of ſulphur, detonate or form fulminating mercury. Another preparation of the ſame kind is formed by a ſolution of 100 grains of mercury in $1\frac{1}{2}$ ounce of nitric acid, aſſiſted by heat. The cold ſolution is then poured on two ounces of alcohol; and by the application of heat a precipitate is formed, which, waſhed and dried, forms fulminating mercury, $1\frac{1}{2}$ grains of which ſtruck on an anvil, violently explode.

DCXC.

With regard to the earthy bodies, there is little to be obſerved with reſpect to their effects upon mercury, except the calcarious earth, or quick lime, is ſometimes

ufed to feparate the acid from mercury, to revive fame preparations of mercury. But mercury may be combined with fome of the inflammable fubftances, as fulphur, and that either by long and patient triture, or more readily with the affiftance of heat. The compound, or fulphuret of mercury, is of an intenfe black colour, and is called Æthiop's mineral on that account. When prepared by triture it acquires a good deal of time; it is firft divided into globules, which becomes lefs and lefs, till it affumes a grey colour. By continuing the rubbing it becomes blackifh; but this ferves only to bring the particles of mercury and fulphur within the fphere of attraction; and it is only by the action of that attraction, bringing them into clofer union, that a perfect Æthiop's mineral, or fulphuret, is produced.

DCXCI.

They unite more perfectly with the affiftance of heat. If the fulphur is melted and poured warm into it, the mixture grows hot, and the fulphur takes fire; and united in this way, they cohere more ftrongly; for heat being applied to the mixture formed by triture, a part feparates; but when they are united, by means of heat, they only fublime together, and affume a deep red, and when reduced to powder the colour is very bright. It is known by the name of vermilion. The change of colour proceeds from a flight calcination, or partial oxydation. In the conduct of the procefs, it is neceffary to employ a ftrong heat in clofe veffels, which are coated, or in earthen veffels; and the heat is fo ftrong, that a quantity of fumes is blown out of the veffel, in order to diffipate the fuperfluous quantity of fulphur prefent in the Æthiop's mineral, more than what is neceffary to conftitute a proper ver-

milion. A quantity of this arifes and takes fire, and the cinnabar or vermilion requires a ftrong heat to its fublimation, and continues in the neck of the veffel.

DCXCII.

The mercury is eafily reftored to its ordinary ftate by means of iron filings, quick lime, or fixed alkali, in a ftrong fire, but the iron filings reftore the mercury the moft readily, the fulphur uniting with the iron, and deferting the mercury.

DCXCIII.

Applying mercury to the other metals, there are three or four with which it unites but very imperfectly, iron, arfenic, platina, and antimony, the combination of which is very imperfect, and the antimony is not retained for any time. It has a particular effect upon arfenic, when it is foul, with inflammable matter: if it is ground with mercury, and the mixture heated by diftillation, the arfenic arifes pure.

DCXCIV.

Mercury can be mixed with many other metals, and thefe mixtures are called amalgams of mercury. If much mercury is ufed, they appear like mercury. If more of the metal, but lefs than an equal weight of it, is ufed, we have a folid bright mafs of a white colour, the mercury holding the colour of the metal. In fuch mixtures, though the other metals appear equally mixed, this does not feem to be the cafe; for when we put fuch a mixture in a leather bag, and expofe it to fome preffure, a quantity of fluid mercury feparates by itfelf, the remainder forming a mafs of a confiderable degree of folidity, and

which consists of equal parts of the metal and mercury; so there is a certain proportion of the mercury which unites itself more strongly, and forms a sort of small crystals; and the rest of the mercury only dilutes this, without mixing in an equal manner. But if such a mass be mixed by long grinding or digestion, the mercury is more closely united, and the other metal more equally diffused. Upon this has been founded the art of separating gold and silver, particularly gold, from the earthy and stony matters with which it is always intermixed, and the foiling of glass for mirrors, for which a sort of amalgam, or mixture of mercury with tin is used. From this also is derived the art of gilding copper, silver, and brass: by dissolving gold in mercury, and exposing it to heat, the mercury evaporates, and leaves the gold. It has been employed to dissolve a leaden ball deeply lodged in a wound, and it serves many useful purposes in medicine and surgery, or it may be employed to take a gold ring off a swelled finger; it will penetrate it, and render it quite brittle, so that a slight stroke will make the ring fly in pieces.

DCXCV.

With regard to its origin, it has been commonly observed that it is a metal which occurs more rarely and in smaller quantity than gold; and as it is more useful than gold, it ought to be more valued, if things were valued according to their intrinsic worth or usefulness. The only mines in which it was found are those of Spain and Hungary, and some in the East and West Indies; these last are the most famous, and have yielded it longest. Great quantities of it are found, in its metallic state, among earthy and stony matter, generally in very small

globules. But in ſome parts it is collected in ſuch quantity that the workmen are expoſed to danger, from the violence with which it ruſhes out of the caverns, when they break them open. It is found too intermixed with the ores of metals, even in hard flint, and in pyrites; and a variety of the ores of other metals have globules of mercury intermixed. But it is more frequent to meet with it in the form of an ore, as combined with ſulphur, either conſtituting a dark red maſs, or produced by the artificial compound called native cinnabar, or they are ſo united as to form a black ſubſtance, like the artificial Æthiop's mineral.

DCXCVI.

The native cinnabar is very like the artificial, but not ſo ſtrained: it is generally in hard lumps; but when ground to a powder it produces a colour as bright as the other. It is extracted from theſe ores always by means of heat. When a ſmall quantity is to be examined by an eſſay, it is uſual to put it into a glaſs retort, and to add a quantity of iron filings, and the mercury comes over in its metallic form. If it is only combined with earthy matter, heat alone will ſerve. When the quantity is large they take an iron pot, and fit it to an iron plate, which is perforated with holes. This is inſerted into another, with a large mouth; a fire is put round the upper pot, to the degree of producing an obſcure heat, while the lower pot is kept cool, by its communication with the ground, &c. But at the mines they follow a method which is ſtill more ſimple, they have a furnace in the form of a lime kiln or draw kiln, only it is vaulted, and there is no iſſue for the ſmoke above; there is only a door by which the workmen enter occaſionally,

and a communication with a little chamber, from which there is an issue for the smoke. This furnace is charged with the stones, and other materials which contain the mercury; the mercury is converted into vapours, which pass along the horizontal vent, and are conducted into the chamber where they are condensed, so that only the smoke of the fuel escapes. In this way large quantities are managed at once, with no expence of vessels, and with very little attendance.

DCXCVII.

Antimony.

The more volatile and brittle metals, which, for want of ductility are called semi-metals, next follow:

The first of which is antimony, or rather sulphuret or regulus of mercury. It has the name of regulus, because it is extracted from a compound which contains it. The chemists do not find this metal in the markets in its pure state, they are only furnished with a compound that contains it, so are obliged to perform an operation upon it; and as they give the name of regulus to metallic lumps, produced from other substances, in crucibles, this has got the name of regulus of antimony. It has been much wrought upon by the alchymists, for what reason is not known, and it has been changed into a variety of shapes, for the purpose of medicine.

DCXCVIII.

It has a white colour, approaching to that of silver, but it is quite hard and inflexible, breaks in pieces upon being struck, and the fracture represents a number of planes, composed of an assemblage of plates cohering together. This particular appearance proceeds from

ſome particular ſort of cryſtallization in its congelation, which makes the parts collapſe in this particular manner. It melts in the loweſt degree of red heat; if the heat is increaſed a little more, eſpecially if the air be admitted, it evaporates faſt, ſending out white fumes; and if a ſolid body is expoſed to it, it condenſes it in the form of a white powder, which is found to be an oxyd of the metal. If theſe ſteams are confined in the veſſel, they give another appearance, and become a ſublimed oxyd. When the matter is put into a crucible, and expoſed to a ſtrong red heat, only allowing a ſlow circulation of air through the veſſels, the ſteams are calcined more ſlowly, and condenſe into ſmall ſhining ſpecular bodies, which have a ſilvery whiteneſs, and from their reſembling ſnow and ſilver, are called the ſilvery flowers, or ſnow of antimony. But we may calcine it by means of heat and air, without converting it into vapour. We reduce it to a fine powder, and expoſe it to a dull red heat, without melting it, when it becomes an imperfect oxyd, and the powder aſſumes a grey colour, and then becomes yellowiſh, and by the continuance of calcination it becomes white.

DCXCIX.

The oxyds of this metal have different degrees of fuſibility, as they are more or leſs oxydated. Thoſe that are perfectly white cannot be melted with any degree of heat, but evaporate when expoſed to a very ſtrong heat and the action of the air at the ſame time. They are eaſily reducible to their metallic ſtate or form, by melting them with charcoal duſt, or black flux, or a mixture of fixed alkali and oil, that is ſoap, which forms a charcoal by heat.

DCC.

In mixture the acids all act upon antimony one way or other. Some of them act upon it in its metallic form, others when it is slightly oxydated; but when it is highly so, none of them have much effect.

The vitriolic acid will not act unless it is strong, and also with the assistance of a strong heat. It is then in part decomposed, and the oxyd formed combines with the remaining acid, composing a salt not crystallizable.

The nitric acid oxydates and dissolves this metal in the cold, the evaporated solution affording a salt deliquescent, and decomposed by heat.

The muriatic acid scarcely acts upon the metal, and it even dissolves its oxyd slowly; but by adding a small quantity of nitrous acid,* producing the compound, which is known in chemistry under the name of aqua regia, or the nitro muriatic acid, it dissolves it briskly, red steams are thrown out; and the solution, when evaporated, forms a concrete, termed butter of antimony, which melts on the application of heat.

DCCI.

The same preparation is composed also in a different way, by mixing the compound of mercury with the muriatic acid, that is, corrosive sublimate with the antimony. Steams arise that condense in the retort and receiver, partly in a fluid form, partly of the consistence of butter, and thus also is obtained the butter of antimony.

DCCII.

This kind of sublimate, or butter, is always in part of

a middling consistence at first; but if it is kept a little exposed to the air, it attracts humidity very strongly, so as to assume a fluid form, and appears very like an oil; but still it retains the name of butter of antimony, or more properly the antimonial caustic, in the London dispensatory. It has the same corrosive quality that the mercury sublimate has. When water is added in large quantity to this compound, it produces a similar effect upon it as upon the compound of mercury and the sulphuric acid. It attracts the acid, and occasions the antimony to be precipitated in the form of a white oxyd; the whole of the acid is washed off, and is called mercurius vitæ, or the powder of algaroth, but improperly, as it does not contain the smallest quantity of mercury.

DCCIII.

The same metal can be combined with vegetable acids, chiefly in their oxydated state. Vinous liquours become violently emetic by means of it. Some time ago this emetic wine was obtained in some of the foreign dispensatories, in a particular manner. Cups were cast of this metal, and the wine being allowed to stand in them became emetic, and the quantity of the metal was so small that the cups might serve for ever. But the methods which are now practised are much more certain and convenient.

DCCIV.

With respect to the neutrals, regulus or sulphuret deflagrates with nitre, and a quantity of white fumes arise, which is found to be an imperfect oxyd of the metal, termed white oxyd of nitre, and which is found to

be less fusible, according to the quantity of the nitrous acid.

DCCV.

Antimony, in the ore, is blended with earth and stones, and is separated from them by putting it into a crucible, perforated in the bottom, and made perfectly close above. One of these crucibles is put upon another crucible, with a hole in the lid of it; and to support the antimony in the undermost, it is surrounded with sand. Over these a fire is put, to give an obscure red heat. When the metallic matter melts it becomes fluid, and runs through the perforation, leaving the earthy and stony matter behind it. The dross remains in the upper crucible, consisting of stony matter, appearing porous from the separation of the antimony, and of a red colour, from a portion of the mineral still adhering to it. The matter collected in the lower crucible is the metallic matter, combined with sulphur, and in that state is called crude antimony, or sulphuret of antimony. It melts with a gentle heat, and the parts, in cooling, crystallize in oblong needles.

DCCVI.

As this is the only operation to fit it for sale, and as it comes in this state into the hands of the chemists, all the operations are to be considered as done upon this compound of crude antimony, and the effect from the application of heat, in different circumstances, and of the different active solvents, will be understood from the knowledge of the two constituent parts, sulphur and the metallic matter. The sulphur of it evaporates when heat is suddenly applied. Its evaporation is attended with a degree of inflammation, which is visible in the dark;

there is a pale blue light, as the fulphur is the moft volatile part. It evaporates the moft copioufly firft; and if a more moderate heat is applied, the fulphur may be totally diffipated, with little lofs of the metallic matter. In this cafe the antimony is to be reduced to a grofs powder, and fpread upon the earthern veffel, which is gradually heated to the loweft degree of red heat, the fulphur evaporates, a luminous vapour hovers over the antimony, and the fmell of burning fulphur continues fome time; what remains is an oxyd of antimony.

DCCVII.

It is from an oxyd obtained in this way that the glafs of antimony is prepared. The roafting being fo managed as to produce an imperfect oxydation, therefore it is ftopped at a certain time, which is judged of by the appearance of the oxyd. Being then put into a violent fire, it melts perfectly into a vitrous mafs, and produces what is called glafs of antimony. As it is usually prepared, it is of a deep yellow or red colour. If the oxyd is more highly oxydated, the colour is paler. If it is not fufficiently calcined, the colour is fo dark that it appears black or opaque. Such therefore are the effects of heat upon crude antimony.

DCCVIII.

In examining the action of the compound falts on fulphuret of antimony, we find the fixed alkali ftrongly attracts the fulphur, and acts upon it in the ftate of a watery folution, but more readily in the way of fufion. The antimony is reduced to a powder, and mixed with the alkali which readily melts it—the alkali unites with the fulphur, and compofes a hepar fulphuris, [illegible]

is a powerful diffolver of the metals in fufion. It is a folvent of many with which the fulphur cannot unite, as gold, tin, &c. So it does not occafion any feparation of the metallic matter which remains combined with the hepar fulphuris thus formed, and the whole is blended into a glaffy-like compound.

DCCIX.

If but a fmall portion of alkali, as one part to five of crude antimony is ufed, it produces the mafs called regulus medicinalis. It is of a black colour when reviewed in the mafs; but by the change of colour it has fome little degree of tranfparency, producing a powder of a reddifh or fnuff-colour. With large proportions maffes are formed, which prove more or lefs foluble in water, as when one part is melted with two of the antimony. This mixture has fuch an attraction for water, as to deliquiate when expofed to damp air. The moft proper name of thefe is hepars, or fulphurets of antimony, as their quality depends upon the quantity of fulphur they contain.

DCCX.

There is another way of producing fulphurets or hepars foluble, by applying the alkali in the ftate of a watery folution to the antimony; but it diffolves it more completely when it is heated. Upon this occafion the metallic matter is diffolved along with the fulphur. The alkali does not attract the fulphur fo ftrongly as to occafion a feparation of the metallic matter; the fulphur does not adhere to the alkali fo ftrongly as pure fulphur would do, and requires more water to its folution. The decompofition appears, when to the folution of the antimony is added a

ſmall quantity of an acid. There is a copious precipitation of the reddiſh or orange coloured matter produced, which is attended with the ſame fœtid ſmell which commonly attends the decompoſition of the hepar ſulphuris, and a hydrogenated hydro ſulphurated antimony is precipitated, or Kermes mineral. In this precipitation the antimony proves more active as a mineral. Unleſs the proceſs be properly managed, that a ſufficient quantity of the acid is employed, it is liable to turn out unequal. When we uſe an ordinary fixed alkali to act upon the crude antimony, it will not act but with the aſſiſtance of a boiling heat, and the greateſt part of the ſolution ſeparates upon cooling, forming a precipitate of an orange colour. This precipitation is called ſulphur auratum antimonii. The chemiſts have given fanciful names to ſuch preparations, from the opinion they had of their virtues; but in the London diſpenſatory it is more properly called ſulphur antimonii precipitatum.

DCCXI.

The Kermes mineral has been highly valued in France, for a long time; it is very ſimilar in appearance to the precipitate, which is ſeparated in this manner, by an acid only; the colour is not ſuch a bright red. The Kermes mineral retains a ſmall quantity, however, of alkali, which the other is free from; and the alkali diminiſhes the quantity of acid in the ſtomach, upon which the activity of the antimonial medicine, not combined with acids, depends.

DCCXII.

The preparations by means of nitre, or nitrat of potaſh, fall next to be examined, and of theſe there

are only two or three preparations now employed; 1st, The crocus medicinalis consists in mixing one part of nitre with eight of antimony, which is so small a quantity that it hardly produces any deflagration; but it promotes the solubility of the mixture, and makes it break like glass, without any sensible degree of transparency, but it has a brightness resembling that of polished steel; it produces a powder of a deep red colour, similar to that of sulphuret of antimony, mixed with a small portion of alkaline salts.

DCCXIII.

Different proportions of the nitre and antimony have been used, as two parts of antimony to one of nitre, which produces the preparation which Lewis calls crocus antimonii mitior. But that commonly called crocus antimonii, and known in this country by the name of crocus metallorum, consists of equal parts of the antimony and nitre; and here the nitre deflagrates very violently. By this proportion a mass is obtained, which, on inspection, consists of a whitish matter that is more saline, and a vitrified substance of a deep yellow or reddish colour is produced. If the whole is melted in a crucible, they separate more completely; the vitrified matter is found by itself, resembling the liver of some animals, so by some is called the liver of antimony; but it is better to confine that term to the preparations with alkaline salts.

DCCXIV.

If two or three parts of nitre is employed, the sulphur is more completely consumed, and the metallic part calcined into a white oxyd. It consists of the calx of antimony, which when separated by water from other matters,

affords a white calx or oxyd, called diaphoretic antimony. James's powder is a preparation like that: from the most authentic accounts it appears to be crude antimony, from which the sulphur is to be evaporated by roasting, and the calx is mixed with an equal quantity of nitre, and kept red hot, which burns the sulphur and oxydates the metallic matter to such a degree as to render it soluble in acids. When it is calcined to a still higher degree, it loses its solubility in acids, and it is freed from every extraneous saline matter by water. In the Edinburgh dispensatory it is called calx antimonii nitrata.

DCCXV.

Wine, and the acetous acid, dissolve antimony. The tartarous is also much employed, and the principal medicine now universally used is the emetic or antimonial tartar. The tartarous acid does not act sensibly on the crude antimony but when moderately oxydated and rendered soluble in acids. So both this preparation and the wine of antimony are prepared with washed crocus, or the nitrous oxyds.

DCCXVI.

The crocus, or nitrous oxyd, is obtained by mixing equal parts of antimony and nitre, and deflagrating the mixture. This renders the metal fusible, being in that moderate state of oxydation in which it is most soluble in acids, and this repeatedly washed in hot water, is called the washed crocus of antimony. But in the apothecaries' shops we meet with a preparation which is totally different from this, and has the opacity and black colour of the regulus medicinalis, and if ground to powder it has a dark, dirty, purple colour, whereas the crocus is of a deep yellow, or of the colour of the liver of some animals; and the powder

is cf a u ight ye'ow colour. This false preparation is formed by melting and deflagrating the antimony with an under proportion of nitre, or they even use a portion of fixed alkali instead of nitre. A great quantity of this preparation is used for horses, and the demand for it has occasioned attempts to prepare it cheaper, so they have left out a considerable part of the nitre, as being the most costly article; here therefore the greatest part of the sulphur remains, and the metal has little more solubility than the antimony in its crude state; and hence we have had so many complaints of the uncertain efficacy of the tartar emetic, or tartarised antimonial wine.

DCCXVII.

It is true that there are other circumstances which may occasion a difference of strength. Thus with respect to the vinum emeticum, the wine may vary in acidity, or its quantity of oxygen, and dissolve only a portion of the antimony, in proportion to its acidity. And in preparing the tartar emetic much depends upon the fine pulverization of the glass, as solid substances are dissolved the more readily the more subtilly their surfaces are divided. It is also necessary to keep the tartar boiling, when it acts upon the antimony, as it is not soluble in cold water itself, and we must use a proper quantity of water to keep it dissolved; it must exceed the quantity of tartar at least 24 times, otherwise it will not act properly, not being held dissolved; and the apothecaries, not attending to these circumstances, have produced tartars very different in point of strength.

DCCXVIII.

In order to find a means of enabling us to judge of them

are properly prepared, we do it by examining its solubility, it being the more soluble the more it is saturated with antimony; and the difference of emetic tartar, in this respect, is very considerable, though now the preparations in Britain are generally of the proper degree of strength, and if rightly prepared, one ounce of water will dissolve 52 grains.

DCCXIX.

Bismuth.

Bismuth, the next metal, bears a considerable resemblance to antimony in its external appearance. It is nearly as brittle, though it bears an impression from a stroke of the hammer which antimony will not do, but breaks like glass. When broken it shews an assemblage of plates, with a shining surface; besides, it is much heavier than antimony, and the colour is a little yellowish, of a reddish cast. It is also more fusible, melts long before it becomes red hot, and melts into a more fluid substance in the fire than most of the other metals do. It is also less volatile, though it evaporates in a strong heat. It is easily oxydated, and the oxyd is easily fusible in a moderate red heat. It is one of the most powerful solvents of the earthy substances, with which it forms a glassy compound. In these properties it greatly resembles the oxyd of lead.

DCCXX.

The oxyd is got from bismuth, by exposing a fresh surface to the air, or more quickly by scorification. It runs off the surface of the metal like oil, and leaves a fresh surface exposed to the air. The calx concreting after fusion, forms a mass of a foliated texture, like the oxyd of lead.

DCCXXI.

The action of the acids on bismuth is pretty much the same as on the other metallic substances.

The sulphuric, by the assistance of a boiling heat, oxydates, and dissolves a part of the metal; but the nature of the compound has not been particularly examined.

The nitric acid is the most ready solvent of the bismuth. The muriatic does not act so well. The nitrous dissolves the bismuth with violence, and copious red vapours break out, consisting of nitrous gas and nitrous acid. At first the solution is of a greenish colour, but upon standing some time it becomes colourless, or the green colour is very much diluted. This solution, [illegible] diluted with water, is decompounded, and a [illegible] is precipitated, which is an oxyd of the bismuth, [illegible] called magistery of bismuth, and is supposed to be the pearl white, which is sold by the perfumers as a cosmetic. But the pearl white seems rather to be a combination of the oxyd of bismuth [illegible] acid [illegible], the bismuth being precipitated from the nitrous acid by means of tartar dissolved in water or a solution of soluble tartar, whereas this precipitate by water retains a small portion of the nitrous acid, which renders it highly corrosive and unfit for what the pearl white is employed for.

The muriatic acid has little attraction on bismuth, except when an oxyd, or when it is used in a boiling heat. The muriat of bismuth distilled forms a thick soft mass; but it has been found applicable to no particular purpose.

The acetous acid produces an acerbent styptic solution.

The alkalies dissolve it after it is precipitated from acids, particularly the ammonia.

With ſulphur it forms a maſs ſimilar to crude antimony; and what is particular, the oxyd combines with the ſulphur as well as the metals.

DCCXXII.

Several experiments have been made upon the mixture of biſmuth with other metallic ſubſtances. Zinc and cobalt can be made to combine with it. The effects it has upon the reſt are generally to change their colour and render them brittle, and theſe metals which are calcinable do ſo more readily when mixed with biſmuth. Such compounds too are remarkably fuſible, more than in proportion to their fuſibility in their ſeparate ſtate; ſo it enters into the compoſition of the ſolders of the more fuſible metals, as for lead and tin, and on this account it forms with mercury more fluid amalgams, added to other metals; as in diſſolving lead lodged deep in wounds it may be added to the mercury. Some time ago it was ſaid to be made uſe of for adulterating mercury, enabling it to diſſolve more lead; but the appearance is ſo different when the mercury contains other metallic ſubſtances, that it is not eaſy to deceive perſons who have the leaſt ſkill in that matter.

DCCXXIII.

Sometimes a little of this metal is added to the compoſition of printers' types, to make it more fuſible. Mixed with lead, tin, and mercury, it forms a fluid amalgam, with which the inſide of glaſs globes are foiled. When warmed this mixture leaves a train behind it, and foils the glaſs, as the globes can be foiled by means of a ſmall aperture on one ſide of it, at which the mixture is poured in, and when cold it becomes hard.

DCCXXIV.

With regard to its origin, it is found moſt plentifully in Saxony; ſome of it is alſo found in France and in England; veins of it are found containing no other metal: but more commonly it is found in ores which are highly arſenical, as in the ore of cobalt, as is the caſe in Saxony. It is ſeparated by the operation of roaſting, as the arſenic is ſeparated. The ſole of the oven has an inclination to one ſide, and the biſmuth melts by the heat raiſed for ſeparating the arſenic, and runs down to the lower ſide, where there is a channel, conducting it into a receiver, the calx of the other metal remaining alone on the floor.

DCCXXV.

Zinc.

The next metal bearing ſome reſemblance to antimony and biſmuth, is zinc. It has a plated texture, a greater degree of ſoftneſs than biſmuth. It will admit of being lengthened out to ſome degree, ſo it is more difficultly broken in pieces. It cannot be powdered by pounding, as the other two, and the colour inclines to bluiſh, reſembling more the colour of antimony, but it has more of the bluiſh caſt. It is among the more fuſible metals, and melts when red hot. In a white heat, in cloſe veſſels, the whole ariſes in vapours, and is condenſed again without any change; but in the open air it takes fire, and burns rapidly, with a crackling noiſe, and ſmoke ariſes which adheres to any body in the way. So the moſt eaſy way of calcining it is to place a crucible in a melting furnace, with about one ounce of the zinc put into it. When heated to a ſtrong red heat, it begins to take fire, at leaſt upon being ſtirred with an iron rod, which breaks a cal-

cined pellicle upon its ſurface, and admits the air, and the oxyd is condenſed upon the ſide of the crucible, or a great part of it attaches itſelf to the bottom around the burning zinc. When a certain quantity of the oxyd is produced, it is very bulky, and then it is neceſſary to ſtir it again, and expoſe the ſurface of the metal to the action of the air. When it is totally burnt we put in a little more, and carry on the operation till that is likewiſe burnt; then we may take out the oxyd which is formed, as the quantity will prove an obſtacle to the convénient calcination of any more: it is done with an iron ſpoon. This is the moſt convenient proceſs.

DCCXXVI.

This metal ſhews the ſtrongeſt attraction for acids of any whatever. It is oxydated, and diſſolves in them all, without exception; in moſt with great violence.

The nitrous acid diſſolves it with heat and ebullition, and the extrication of red vapours, or nitrous gas, as uſual. And the ſulphuric and muriatic acids alſo diſſolve it with great effervefcénce.

The vegetable acids act alſo very readily on it, and acquire a ſweetiſh ſtyptic taſte, as from lead.

DCCXXVII.

With regard to the other metals there are none with which it will not combine, except biſmuth and nickel. It is diſpoſed to unite with iron, but the iron muſt be heated ſo much that the zinc takes fire, and is loſt; and in this caſe it is apt to carry off a part of the other metal, particularly of thoſe metals which are moſt calcinable. So it has the leaſt effect in this way upon gold and ſilver.

DCCXXVIII.

The most useful combination with tin is to produce the compound called pewter. Tin is the predominant ingredient, but by itself it is too soft, and it is necessary to add other metallic substances to give it hardness, and zinc answers the best, its whiteness resembling that of silver, only it is too easily affected by acids.

DCCXXIX.

With copper zinc produces brass, and other compounds, called, by the solderers, spelter solders. And it produces with copper the imitation of gold, called princes metal, the zinc giving a yellow colour to the copper, though it is white itself. It does not diminish the ductility much, resembling gold in appearance and colour. It has such a toughness and ductility as to be beat out under the hammer, and to be drawn into very fine wire, and has a certain consistence rendering it a fitter material for workmen; and being softer than the copper, it is easier made into a variety of utensils, and has farther the advantage of bearing better the effects of the air. The preparations of copper and zinc, to produce the exact imitation of gold, have been considered by several chemists, and it is found that nearly an equal weight is necessary; but unless they are fine, they produce a brittle metal. The copper must be refined by means of lead from sulphur and arsenic, which adhering very strongly to the copper, it forms a very brittle composition. Many manufacturers pretend to secrets in this way, and to produce better compositions than ordinary.

DCCXXX.

With regard to the origin of the metal, for a long

time we were ſupplied only from two ſources, the Eaſt Indies and China; the only other place was from Germany, from a particular ore at Ramelſburgh. We had no account of the proceſs uſed in the Eaſt Indies, but the proceſs uſed at Ramelſburgh was pretty well known. The ore is wrought chiefly for ſilver, but there is a large proportion of lead, and beſides there is a quantity of the ore of zinc. In working this compound ore they melt it in the uſual furnace. Having a quantity of looſe charcoal at the bottom, the lead runs down to a cavity, defended from the action of the heat and air, that it may be burnt. In the furnace, or tower, in which the fuſion is performed, there is oppoſite to the naſſal of the bellows the oppoſite wall of the furnace, compoſed of two thin ſtones, one next to the fire, the other next to the external air, and a cavity between them; for there is a thin partition formed between the tower and the external ſtone, or the front wall is double. That part of the ore containing zinc is by the heat and contact of the fuel reduced to its metallic ſtate, and being converted into vapours, theſe are drawn forwards towards this partition, through the interſtices of the ſtones, into the cavity in the middle of the wall, and the external partition which defends them from the external air, is kept cool by throwing water upon it, the ſteams are condenſed, and after a day or two, or more, ſuch a quantity of zinc is collected, that it is worth while to take it out; ſo in this way a ſort of diſtillation of the zinc is carried on.

DCCXXI.

This was the only place where zinc was obtained in Europe, although the ores of it were ſufficiently known

as ſuch, from their effect in making braſs. They contain the zinc in the ſtate of an oxyd, and form maſſes of different degrees of hardneſs. They are generally of a yellowiſh colour, ſome reſembling a ſtone; ſo commonly called lapis calaminaris, or calamine ſtone. This has been long employed in the making of braſs; and conſidering the effect of the zinc in this way, they concluded that it was the ore of this metal. The calamine is generally ſeparated from ſulphur adhering to it, or other ores mixed with it, then it is ground to powder, and mixed with a quantity of charcoal duſt, and put into pots or crucibles; over this are laid plates of copper, then over theſe more of the mixture, ſtratum ſuper ſtratum; and a number of veſſels, charged in this manner, are put into a furnace, and the heat is raiſed ſo as to bring the braſs into fuſion. The furnace is then allowed to cool, and they find the copper converted into braſs, and it is found to have increaſed $\frac{1}{3}$ of its weight during the proceſs.

DCCXXXII.

Lead.

We next come to lead, which is the ſofteſt of all the metals: it is ſo totally void of elaſticity, that it produces no ſound, when ſtruck. But though it is remarkably ſoft, it is generally leaſt ductile and malleable; it cannot be beat into thin leaves, or drawn into fine wire. It has but a ſmall coheſion of parts: its fuſiblity is well known. It is alſo volatile in that degree of heat which makes it calcine faſt, if the free air is admitted. When it is paſſing from its ſtate of fluidity, it paſſes through a particular ſtate, in which it can be eaſily divided into ſmall particles; cooling it gradually, and ſtirring it with a ſtick, the parts cohere like wet ſand; and ſtirring it briſkly, it

is divided into particles, like feeds, and this is called granulation. This is fometimes managed by having an oval wooden box, the middle of which is rubbed with chalk; the melted lead is inclofed in this, and fhaken violently, and a quantity of it is reduced to thefe grains; but the procefs fucceeds better in the other way, when it is put into an iron mortar, which cools more flowly, and allows more time for dividing its parts, when it is in that particular ftate of cohefion.

DCCXXXIII.

The manner of making it into fhot is fufficiently curious. It is made to run through an iron cylinder into a quantity of water, to which a little arfenic or orpiment is added, which difpofes it to affume the form of round drops, but only a number of them are round, the moft of them are in the form of pears, conical; thefe are feparated by making the whole run down an inclined plane, they running to a fide. The fhot is afterwards divided into different fizes, by means of iron fieves.

DCCXXXIV.

This metal is very calcinable in a heat a little above that neceffary to its fufion. When it is merely kept melted in the fire, it is foon tarnifhed, a pellicle is formed, or imperfect oxyd; and drawing this afide, and expofing a frefh furface to the air, that in like manner becomes tarnifhed, and fo we can form the whole into a droffy fkin. It is thus formed into a kind of grey or green coloured powder, which is an imperfect oxyd of the metal. The lead is oxydated more quickly, in the way of fcorificadion, by a ftronger heat; it collects into a droffy cover over the lead, and unlefs it is feparated or blown off, the fcori-

fication does not proceed very fast. Great quantities of lead are changed very often, in a process of this kind, in the operation of separating silver from lead. There are few lead ores which do not contain some silver; so the lead is separated by scorification, and the silver is not oxydated, but remains in its metallic state entire, when the lead is calcined.

DCCXXXV.

The process in this large way is managed by heating the lead on a hearth, till it is heated to the scorifying degree; by means of two pairs of bellows, the air is directed on the middle of the surface of the melted lead, which makes it scorify very fast, and at the same time the scorified parts, or melted litharge, is blown off towards the opposite side, where there is a channel to conduct it out of the furnace, otherwise it would cover the surface, and defend it from the action of the air, and thus it is had in shining scaly particles, of a reddish colour. When it is allowed to cool in rest and tranquillity, it forms a solid mass, having a yellowish colour; the internal texture resembles some of the talky bodies and antimony, zinc, or bismuth. It is composed of plates, assembled together in crystallizations, and it is called litharge.

DCCXXXVI.

This oxyd does not suffer much change from the action of heat and air alone. It is volatilized 'till it totally disappears; but it changes its appearance greatly, when oxydated with a reberated flame of wood. It is reduced to a fine powder, and exposed on the sole of an oven, so that the flame may be beat down by the arch, so as to play upon the surface, the vent being in the opposite

fide of the oven, called mafticott. This changes its colour gradually to an orange, and ends in a pretty bright red, and it is called red lead, or minium. This requires two or three days; the calx muft be frequently ftirred, and care taken that the heat be not raifed too high, fo as to bring it into fufion, otherwife it lofes the red colour, and forms litharge. All thefe calces are very fufible, though not fo much fo as lead itfelf.

DCCXXXVII.

We have alfo the litharge auri et argenti. The litharge auri is more of a yellow or orange colour, and is generally produced in the procefs for extracting filver from lead, the heat being raifed by the flame of wood, which gives it a little of the orange caft. In other cafes, where the heat is produced by means of other fuel, the litharge is more of a whitifh colour, retaining fome of the lead intermixed. But thefe terms are now laid afide, as there is only one fort of oxyd of lead, and the colour depends only on the circumftances of the oxydation.

DCCXXXVIII.

The calces of lead eafily return to their metallic ftate, by melting them with $\frac{1}{8}$ part of their weight of coaly matter. Thus when we burn common red wafers, which are made of fome kind of pafte, coloured with red lead, if we fet fire to them, after the moft volatile parts are diffipated, while the charcoal is burning, little drops of lead form.

DCCXXXIX.

Thefe oxyds are alfo revived by their fufion with fome other metals, as iron, &c. If litharge is melted with

filings of iron, the most part of it is restored to its metallic state, and most part of the filings are scorified. From this is understood the use of the grease, and other oily substances, used in melting lead, grease, tallow, or resin, when the surface becomes bright again. These substances act partly by absorbing the oxygen of the calx, making the metal return to the form of lead. They easily endure the degree of heat sufficient for melting the lead; and being lighter, they always keep at the top, and prevent the action of the air.

DCCXL.

Lead has a strong attraction for the sulphuric acid, with which it forms an insoluble compound, and added to a solution made by other acids, it precipitates them, and forms a similar compound; and this not only happens when the pure acid is added, but when a salt is added, which contains it in however so small a quantity, a proportional part precipitates; so a solution of lead in other acids is a very nice test of the vitriolic acid in mineral waters. So when there is added to water, containing a solution of lead, the most minute quantity of the vitriolic acid, a turbidness ensues, and precipitation. This does not take place with the nitrous acid, and the same thing happens when the compounds of this acid with the fixed alkalies are used. But though the vitriolic acid shews such a superior attraction for lead dissolved in other acids, it acts slowly on the lead, except as an oxyd.

DCCXLI.

The nitrous acid, or aqua fortis, is the most ready solvent of this metal; it produces a perfect solution with moderated effervescence. The solution can be reduced

to the form of a dry falt, or nitrat of lead, affording white cryſtals.

DCCXLII.

The muriatic acid forms a white oxyd, which has a moderate degree of ſolubility in water. It unites with the lead more readily, by adding any neutral ſalt which contains the muriatic acid, to a ſolution of lead in the nitrous acid; thus a precipitate of the lead and muriatic acid is occaſioned. The muriat of lead, expoſed to a moderate heat, melts into a tranſparent horn-like matter, called plumbum corneum, from its ſimilarity to a compound produced from ſilver, which melts in the ſame manner, proves tranſparent and flexible, and is ſo ſoft as to be cut with a knife like a horn; ſo from its reſemblance to horn in theſe particulars, it has been called argentum corneum, and its only remarkable quality is a powerful aſtringency; it is the moſt powerful aſtringent ſubſtance of any to be met with.

DCCXLIII.

The other acids act chiefly on lead, in the ſtate of oxyd. They act eſpecially on a ruſt of lead, a particular oxyd or corroſion formed by means of the vegetable acid itſelf. This preparation is much uſed in ſome of the arts, and is well known under the name of white lead or ceruſs. It is obtained by expoſing plates, in cloſe diſtilling veſſels, to vinegar, which is kept conſtantly riſing in ſteam. The plates are ſoon covered, to a conſiderable thickneſs, with this corroſion, which ſtarts off on the lead being unfolded; and this being reduced to a fine powder, is called white lead. It is chiefly from this ſort of corro-

fion the combination of the vegetable acids with lead are obtained.

DCCXLIV.

The cerufs, digefted with vinegar, communicates a fweet aftringent tafte to it, and takes off its acidity. The folution being evaporated, affords a falt which readily diffolves in water, and from its fweetifh tafte is called faccharum faturni, or ceruffa acetata. When it is defired to have it in more folid cryftals, it may be diffolved with more vinegar, and evaporated again, whereby a greater quantity of oxygen is combined with the lead, and forms a more foluble cryftallizable falt.

DCCXLV.

All the oxyds of lead are eafily decompounded by the application of alkalies, or abforbent earths. Thus the folution of lead in the nitrous acid, diluted with water, is rendered turbid, by the fmalleft quantity of alkali, or calcarious earth.

DCCXLVI.

The effects of alkaline falts upon lead are not different from thefe they produce on the metallic fubftances in general. Melted with lead they diffolve or corrode a part of it, efpecially in their cauftic ftate, and nitre calcines it in a proper degree of heat, converting it into litharge; and as the proportion of nitre is but fmall, there is no confiderable deflagration.

DCCXLVII.

In the hiftory of moft other metals not much is to be faid with refpect to the earths; but this is not the cafe with refpect to lead. One of its moft diftinguifhing or

useful qualities is a power which its oxyd possesses of melting, or dissolving more or less readily, all the earthy substances, without exception, uniting with them in the form of a glass. It has this property in so eminent a degree, that no vessels can confine it, for any time, in the fire; and as it is employed in metallurgical operations, it is usual to mix it with earthy matter, to abate this dissolving power, and it is called glass of lead; being two or three parts of litharge with one of flinty matter, which rather exceeds the litharge in bulk.

DCCXLVIII.

The most proper materials to mix with lead, in these cases, is the purest kind of clay; and as it is necessary to add some dividing substance, the use of burnt clay is recommended, beat into a powder, like sand, and mixed with the fresh clay. But still such crucibles contain the oxyd of lead for a long time, only, for they are dissolved at length. The reason why the chemists have shewn such a desire to discover proper vessels, is an opinion which has prevailed among them, that lead by repeated fusion and reduction may be converted into silver. In consequence of this supposed quality, this metal is much employed in the treatment of gold and silver, &c. These metals are melted with a large quantity of lead, and part scorifying brings the ore into fluidity, and the metallic part separates, and mixes with the lead at the bottom, and the lead is easily separated by scorifications.

DCCXLIX.

It is much employed also in the composition of the finer kinds of glass, from its dissolving the earthy substances so readily, especially the flinty earths, with which,

in certain proportions, it forms a fine glafs, the lead giving it a greater degree of tranfparency, rendering it more void of colour and more fufible. It continues flexible and tough in the loweft degree of red heat, fo it is eafier to work and finifh the glafs. The common glafs, which is called flint glafs, contains a large proportion of lead, which is eafily extracted from it; and when fuch compofitions are made with particular attention and nicety, a glafs may be formed of remarkable brightnefs and tranfparency, refembling the diamond pafte fo much that good imitations are made of the precious ftones, called paftes. Thefe are made of the pureft kinds of the flinty earths with refined fixed alkali, borax, and the calx of lead. The ufe of the calx is to communicate to the glafs a power of difperfing the colours of the light. Tranfparent bodies have two effects on the light; one is refraction, a bending of the ray out of its courfe on going into, and in paffing through it, it is bent towards the perpendicular of the furface. But befides, they feparate the colours of the light from one another, fo that after two or three refractions it is converted into different colours, and lead gives it more of the colour which is fo remarkable in the diamond. No matter has fo much power in difperfing the colours of the light as the diamond, and thefe paftes have it to a very great degree. This fort of glafs is not ufed for mirror plates, as it is never very equal in denfity, which occafions an irregular refraction of the rays, and thus forms the phenomenon which is called eels, as in the ftoppers of decanters, where the parts are of different degrees of thicknefs or denfity, in confequence of their containing more or lefs of the

calx, the parts which are uppermoſt loſing a little by evaporation.

DCCL.

When the calx of lead is very redundant, and not highly calcined, it communicates a yellow colour, which is produced in the glaſſes, made to reſemble the topaz, &c. and it is called the glaze of the lead. The glaze of the common kind of earthenware is of the ſame kind; it is made by a rude kind of vitrification; the ore of lead is duſted on the ſurface of the ware, or a mixture of minium with the flinty earth is uſed, and the heat applied to the ware proves ſufficient for vitrifying, that making it act upon the ſurface of the ware; and as the degree of heat is not very ſtrong, the glaze has always a yellow colour. The lead is eaſily recovered from ſuch glaſſes, it need only be reduced to powder, and melted with a ſmall quantity of charcoal duſt, or an alkali may be added, to bring the earthy matter into fuſion, ſo as to allow the particles of the lead to ſettle to the bottom; and it may in like manner be recovered from glaſs which contains a ſmall quantity of it, as the common flint glaſs. Hence this ſort of glaſs which is employed in making the tubes of barometers and thermometers is liable to be ſmoked or blackened with the flame of the blow pipe, and it requires ſkill to ſeal up the tube without making it opaque.

DCCLI.

With reſpect to the inflammable bodies, the oily ſubſtances, without exception, diſſolve lead, and there are none of theſe which diſſolve it more perfectly than the fixed or unctuous oils. The diſſolution of the oxyd in theſe oils, requires the aſſiſtance of ſome heat, as that of

DCCLIV.

Oils alfo are fophifticated by this means, when they grow rancid; a quantity of lead diffolved in them corrects the bad quality: but fuch oils, mixed with a folution of fulphur, are changed in their colour, in like manner as the wines.

DCCLV.

It is for the fame reafon that the oxyds of lead are liable to a great inconvenience, as a pigment, particularly the white lead, when ufed in water colours. They feldom retain their whitenefs, efpecially if they are in the neighbourhood of corrupted animal or vegetable fubftances; they acquire gradually a dark colour from fulphurated hydrogen gas.

DCCLVI.

With refpect to the other metals, it is mixed with them all, except iron and cobalt. Of this laft it diffolves a fmall portion, but the reft remains difunited. It mixes with all the reft, increafes the difpofition of all the other metals to fcorification; fo on this is founded the methods of feparating the other metals from gold and filver; a large quantity of lead is added, which being fcorified, the other metals are oxydated, and the gold and filver, which refifts the heat and air, remain at laft pure.

DCCLVII.

The ores of this metal are among the moft plentiful of any, particularly in this country, and are not of any great variety; the only ore is what is called the golind plumbi, a compound of lead with fulphur. When it is pure, and in large quantity, it breaks into rectangular

masses; on other occasions it is found not of so regular a structure, the grain being more confounded by an admixture of arsenic, and perhaps antimony. When it is found in thin veins, it is composed of small masses, but these break much in the same manner into rectangular particles; this is called a steel grained ore; the particular appearance depends upon the thinness of the ore, the ore having been disturbed in its crystallization by the neighbourhood of stony matter with which it is surrounded. In the veins of these ores there are some varieties met with which are only accidental, though these varieties are found in some of the veins of this country which are very rich of lead, particularly in the white lead ore, which is an oxyd of the metal. It crystallizes into oblong crystals, composed of fibres, having a silvery shining appearance, resembling the crystals of salts. Sometimes they are found tinged with various colours, from the additions of some earthy matters in their formation. Some of these white crystals are sometimes united together, but very loosely, as those occurring in the cavities of veins.

DCCLVIII.

There is a noted ore of lead which is green; this often forms a crust upon the stone, or other mass of ore, the surface of which is formed into a number of protuberances. It is difficult of reduction, and appears to be an oxyd of lead, combined with a quantity of muriatic acid. Others are of a yellowish colour, from a small quantity of the oxyd of antimony.

DCCLIX.

The manner of extracting the metal is simple in this country. Abroad, where the ore is impure, and mixed

with pyrites and a great quantity of sulphur, this occasions a great loss of the lead, so that they must roast the lead ore, in order to dissipate the sulphur, and the pyrites is burnt into red ashes, containing an oxyd of iron, which can be washed off with water. But when the ore contains nothing but sulphur, it is melted immediately in a particular furnace, in which the heat is but very moderate, but which is sufficient to the air to dissipate the sulphur, and make the lead melt into its metallic form.

DCCLX.

Tin.

The next metal that falls to be examined is tin, the external appearance of which is well known. It has a whiteness resembling that of silver, in its pure state, and the purest form is called grained tin. When we break a large mass of it, in its cooling state, it divides into long fragments. It is one of the softest metals, and has a great degree of malleability; but it is not ductile into wire. It has one particular quality, it produces a crackling noise when it is bent, probably owing to some impurity; and touching it with our teeth, our sense of hearing is rendered more acute, by the vibration communicated to the bones of the head. It is more easily melted than any of the perfect metals, and passing again to a state of solidity, it undergoes a particular state of cohesion, like to that which lead passes through. In consequence of this it can be reduced into small grains. It is also easily oxydated in an obscure red heat. When the heat is raised to a certain degree a grey powder is obtained, and in a still stronger heat this powder becomes white. Its oxyds are not in the least fusible. There is indeed

one way of producing the glafs of tin: we put it into a crucible, the upper furface is oxydated; and the under portion retains its metallic form; the middle one is in a ftate of imperfect oxydation, or in a ftate refembling glafs.

DCCLXI.

By the action of the different acids it is alfo eafily oxydated. The fulphuric acid oxydates it without diffolving it, and the fulphureous forms with it a fulphurated fulphate of tin. The nitric acid precipitates it in a white oxyd, but the tin is not diffolved. This oxyd is perfectly infufible, and it is with difficulty reduced to tin again. A nitrate of tin is obtained by the nitrous acid diluted, and applied cold.

DCCLXII.

The nitro muriatic acid, or the aqua regia, diffolves the tin, if the metal is put in flowly, and forms a folution of a tranfparent colour. The manner of making that folution has been much ftudied, as it is neceffary in forming a particular precipitate of gold ufed in enamel painting, and it is neceffary to the dyers of fcarlet, for changing the natural colour of the cochineal into a red fcarlet; but if the metal is put in too haftily, or is not kept very cold, it is fo much oxydated that it will not diffolve in the other acid; fo the whole art is to keep the liquor cool, and to add the tin flowly, when we have a folution that has the qualities for the purpofe. The beft proportions of the liquor are two parts of nitric and one of muriatic acid. This folution of tin is alfo ufed for precipitating gold from aqua regia, for colouring glafs.

DCCLXIII.

The muriatic acid diffolves tin, cold or heated, pro-

ducing a muriat of tin; but the oxyd is imperfect, and absorbs more oxygen, if presented to it. A particular preparation is the oxygenated muriat of tin. Thus mercury sublimate being mixed with powdered tin, the acid quits it, and forms a compound like the butter of antimony, but it is more fluid and volatile. It emits copious white vapours, so it is called the smoaking liquor of Libavius. It is highly corrosive, similar to some of the other compounds of the muriatic acid.

DCCLXIV.

The vegetable acids have little action upon tin, in its metallic state. They oxydate it a little; but it is employed to defend the surface of some other metals which are more easily affected by vegetable fluids.

The neutral salts act upon it, both in its metallic and oxydated state.

DCCLXV.

With vitrified earths the oxyd of this metal constitutes the white enamel with which the dial plates of watches are covered. They are made of a tender and fusible glass, to which the oxyd of tin is added, which not being fusible, gives a beautiful whiteness to the glass.

DCCLXVI.

When combined with sulphur it forms a dark coloured matter, which is not so fusible as tin, but the compound is different, according to the oxydation of the tin. Thus without its oxydation we have a mass consisting of sparkling particles; when oxydated we form a curious product, a compound called aurum mosaicum, or sulphuret of tin. It is a substance composed of very beautiful flaky par-

ticles, which are very light, ſo as to float in the air, and rubbed between the fingers and thumb, it ſeems ſmooth and ſlippery, and has a pretty bright golden colour. This product is obtained by uniting the ſulphur to the tin, in a particular manner. The proceſs commonly uſed is to mix together ſulphur and tin. The tin, (12 ounces) is divided by means of mercury, (ſix ounces,) which renders it a brittle amalgam, ſo that it can be reduced to a fine powder; to this is added a quantity of ſulphur, (ſeven ounces,) and ſome muriat of ammonia, or ſal ammoniac, (ſix ounces,) and the mixture is ſublimed. This production, rubbed on other bodies, gives them a gilded appearance.

DCCLXVII.

Tin unites with all the other metallic ſubſtances, though it is ductile itſelf, and can be beat out into plates or leaves. It totally deſtroys their malleability; ſo gold has its toughneſs deſtroyed by ſuch a minute quantity of tin, that the goldſmiths uſe the utmoſt caution that no tin even approach the furnace, as the very vapour of that metal is ſufficient to render the gold more brittle.

It is added to copper or braſs in conſiderable quantity, to give elaſticity to them at the ſame time that it gives brightneſs to them: ſo the metal of bells is of this kind.

DCCLXVIII.

The other uſeful mixture is pewter, which conſiſts of tin alloyed with a quantity of lead, and in ſome countries the alloy of lead is regulated by law. Block tin, or tin in a pure ſtate, is employed occaſionally, on account of its whiteneſs, reſembling that of ſilver; and zinc is ſometimes added, which renders it hard, and at the ſame time

remarkably white. Some of thefe mixtures have a great degree of fufibility. It is a general rule that the metallic mixtures have a great degree of fufibility, and that they are more fufible than the medium fufibility of the metals entering into their compofition. This is the cafe with regard to the mixtures of tin, to fuch a degree that the metal can be compounded, which is more fufible than any metal we know, and will become perfectly fluid with the heat of boiling water. It confifts of five parts of bifmuth, three of tin, and two of lead. When we pour boiling water upon this mixture it becomes foft, and keeping the water boiling it becomes fluid; fo it has been propofed as a proper mixture for anatomical injections. It was fuppofed that it might eafily be thrown into the veffels of the different organs, that the animal matters being difcharged by putrefaction, the metal would be left moulded by the veffels, but the experiment does not fucceed. It has too a confiderable degree of hardnefs and toughnefs, and the degree of heat neceffary is the pure heat of boiling water, or nearly that. Below that heat the metal is not fluid, and animal fubftances do not bear the full heat of boiling water without being corrugated and contracted, whereas in order to inject an organ, they macerate it in tepid water, in order to relax the veffels as much as poffible.

DCCLXIX.

With regard to the ores of tin, it is rarely found pure; and in its metallic ftate it is yet in the form of an ore combined chiefly with arfenic, and concreted into hard maffes of a deep yellow colour, with fome tranfparency. Thefe are called tin grains or cryftals; they are generally

intermixed with a confiderable quantity of ftony matter, and other materials; often intermixed with a flinty earth or quartz, and with the ftony fubftances called churl. Sometimes it is mixed with an ore of iron, and is reddifh, and this is reckoned a lefs valuable ore. There are feparate grains found in the gravel of brooks, where the rubbifh of mountains is wafhed down, and a ftream of water wafhing away the lighter gravel, leaves the grains of tin ore, which the people gather up. Thefe are remarkable, as being one of the heavieft of the mineral fubftances, containing the tin combined with arfenic, and at the fame time thefe cryftals are very hard, fo it is one of the metals upon which the practice of elutriation is the moft fuccefsful.

DCCLXX.

All thefe ores of tin are pounded down to a meal, which is wafhed carefully to get rid of the ftony matter, when it is fuccefsfully heated. It is neceffary, previous to its fufion, that it be roafted, in order to diffipate the arfenic as much as poffible. If it contains any pyrites it is foon brought to a red colour, fo as to leave the grains of tin free from iron and fulphur.

DCCLXXI.

Iron.

From tin we proceed to a metal of more importance, iron, which poffeffes a combination of properties that have made it a noble fubftance for the ingenuity of man to work upon, from its hardnefs, its toughnefs, and the ftrong cohefion of its parts, which can be modified fo as to have either toughnefs and hardnefs, or a middle ftate of elafticity. To thefe if we join the great foftnefs

it acquires when heated to a certain degree, which enables us to form or faſhion it, and the diſpoſition the different parts of it have to cohere, when heated, to one another, which alſo facilitate the formation of different inſtruments, we ſhall have all the qualities in conſequence of which it is ſo uſeful. Examined in its cold ſtate it is conſiderably obdurate and rigid under the hammer, but it is capable of being drawn into very fine wire, as ſome harpſichord wire, which is very ſmall.

DCCLXXII.

It is the only metallic ſubſtance which is affected by the magnet, as it is not only affected by that natural ſtone, but it is capable of being changed into magnets, acquiring the magnetic quality in a very great degree. The proceſs for this is very curious, and among the moſt extraordinary and unaccountable proceſſes in natural philoſophy. Bars of ſteel, hardened to the greateſt degree, are laid at one another's ends on a table, other bars are then laid in certain poſitions with reſpect to the former, they are rubbed upon one another, then the bars are changed, and the operation repeated till they become powerful magnets.

DCCLXXIII.

The chemiſts have taken advantage of this power, to purify iron filings from other metals, &c.; and to prevent the magnet from raiſing them in great bunches, it is proper to ſpread on the top of them a piece of fine gauze, or the bottom of a ſieve; and by means of the magnet to draw up the filings through the gauze, and thus we can have them quite pure.

DCCLXXIV.

This metal, in its moſt ductile ſtate, is hardly capable of fuſion in cloſe veſſels: in its more crude ſtate it is more eaſily melted. Pig iron runs down from the ore, is melted without difficulty in a violent fire, and even tough iron heated with gypſum, in the way of cementation, can be rendered fuſible; but taking it in its tough ſtate, it is perfectly infuſible in cloſe veſſels, when heated to a violent degree; however it is very ſoft, and in that ſtate different pieces can be made to cohere. The black-ſmiths, when they practiſe this, throw into the fire a ſmall quantity of ſand, or a bit of free-ſtone compoſed of ſand; this melts on the ſurface of the iron, when the ſurface ſhines like glaſs, and by a ſtroke of the hammer they come into perfect fuſion: ſo the uſe of the ſand is to keep back the ſcoriæ in a ſtate of fluidity, that it may ſeparate immediately when the two pieces are applied, and allow the pure iron to come into contact; and it is as little an obſtruction as if it were water, or any other fluid: ſo the ſand anſwers the ſame purpoſe for welding as the borax does in ſoldering the other metals.

DCCLXXV.

When iron is ſuddenly cooled after it has been violently heated, it is harder and leſs pliable than before. When expoſed to a moderate heat it undergoes a ſlight degree of oxydation, and the firſt phenomenon is the appearance as of rainbow colours, which ſucceed one another when the iron is approaching to a red heat. So if a poliſhed rod of iron is put with one end into the fire, that it may be heated gradually, the part at which the heat enters becomes of a yellow colour, aſſumes a gold or orange colour, then

appears purple, then of a violet colour, then ends in a deep blue, and when heated ftill farther, the blue is weakened, when beginning to be red hot. On the rod of iron we can obferve all this; at the end next the fire we have the colours produced by the greateft heat; and farther on we have the colours produced by the lefs degrees of heat; and if the iron is made of a dull red heat, the oxydated matter increafes in thicknefs, fo as to form a grey matter of an earthy appearance. When the iron is fuddenly plunged into water, the oxydated part can be made to fly off in the form of a fcale; fo the colour depends upon an exceeding thin oxydated pellicle, which reflects certain of the rays of light, and no other; but when it has arrived at a certain degree of thicknefs, it abforbs them entirely, and appears of a dark grey colour.

DCCLXXVI.

This part ground to a powder, when expofed long to the action of heat and air, is changed to an oxyd of a deep purple colour, which is the natural colour of the oxyd of iron. The oxyds of iron being either purplifh or of a yellow colour, are called croci, the yellow prevailing in the greater number.

DCCLXXVII.

The oxyd is eafily reftored to a metallic ftate, fo far at leaft as to bring it under the power of the magnet, and to give it a dark colour, by mixing it with oil, or tallow, or charcoal duft, and keeping it red hot for fome time.

DCCLXXVIII.

When the iron is oxydated to a certain degree, the

magnet has ftill fome power over it; but when oxydated ftill farther the magnet lofes its power. Upon this is founded the method of detecting fmall quantities of iron mixed with earths and other matters: and in the afhes of moft animal and vegetable fubftances, when they are kept red hot with inflammable matter, the magnet attracts fmall particles which are found to be iron, though it requires an intenfe heat, and it is difficult to fucceed in this.

DCCLXXIX.

Iron is diffolved and oxydated by the feveral acids, and it is alfo oxydated, at a low temperature, by expofure to the air. Hence it has been a defideratum to preferve iron from rufting. The moft fuccefsful methods are to apply different varnifhes of the oily kinds, particularly the drying oils, lintfeed, walnut, &c. To thefe are added a fmall quantity of lead; fome of the calces of this metal are diffolved in them, which haftens the drying, and increafes the thicknefs of the varnifh. Others add different refinous fubftances; but one of the moft fimple means is practifed in the works where much iron is manufactured, where axes, &c. are made. They have a veffel with lime and water, with which they wafh the utenfil, and then throw it afide; the water evaporating leaves a fmall film of calcarious matter, which proves a varnifh or defence from the injuries of the air for fome time after. If iron is heated till a thin oxydated cruft is formed upon it, it will preferve better from rufting in that ftate: fo many nice works are heated to fuch a degree as to form that thin blue film, or oxydation, as the fprings of watches, &c.

DCCLXXX.

To diſſolve the iron, the ſulphuric acid, when concentrated, requires the aſſiſtance of a boiling heat; but when diluted to three or four times, the ſolution proceeds rapidly in the cold. By this ſolution a large portion of hydrogen gas is diſengaged, having a heavy diſagreeable odour, which is perceived when the ſteams have diffuſed themſelves through the room; a conſtant flame is perceived alſo at the mouth of the veſſel. When the ſolution is completed it turns out a liquor of a pale green colour, which by evaporation affords cryſtals which are green, eſpecially when freſh. They are of a pleaſant light green colour, but when kept ſome time they are liable to become yellowiſh. This is the ſubſtance called ſulphate of iron, or green vitriol. It is not produced for ordinary purpoſes in this manner; it is obtained much cheaper from pyrites. It contains a great quantity of water, fully the half of its weight, ſo undergoes the watery fuſion, and the compound of iron and acid remains behind in a white concreted maſs. Increaſing the heat further ſome of the acid begins to evaporate, and leaves the iron in the form of a reddiſh calx, and there is always ſome little loſs of the acid, which gets away with the water. Increaſing the heat farther, more of the acid evaporates, and the oxyd of the iron is of a deeper colour. And ſtill farther increaſed to a red heat, the acid is totally diſſipated, and we have an oxyd of the iron, of a deep red colour, inclining to purple.

DCCLXXXI.

Nitric acid immediately attacks iron with violence, and is raiſed in red vapours, or nitrous gas diſengaged.

In order to have a perfect folution without diluting the acid, when its operation is flow, the folution is kept as cool as poffible, by putting the veffel in a quantity of cold water; and further, the iron is added but flowly, that the acid may not grow hot with it; fo we do not put in filings which have fuch an extenfive furface. We have iron wire broken into little bits, and put in only one of thefe at a time. It acts with a moderate effervefcence, and the acid is gradually tinged of a gum colour; this colour increafes till the acid is faturated, when it affumes a pale yellow colour. When the folution is formed with lefs caution from the beginning, it turns out of a brown rufty colour, as we generally add a little water to the glafs, or dilute the acid in which the iron filings are diffolved. None of thefe folutions give any cryftals before they become dry. Nitrous gas is copioufly difengaged during this procefs, and the iron is left in the ftate of an oxyd.

DCCLXXXII.

The muriatic acid alfo diffolves iron readily, and produces a moderate degree of effervefcence, fomewhat in the fame manner as the fulphuric does, which is attended too with the production of hydrogen gas, having the fame heavy offenfive fmell. This folution too turns out of a green colour; by proper evaporation it affords cryftals like the fulphate. This acid has alfo a remarkable power over the oxyds of iron, diffolving thefe more readily than other acids. When it acts on the oxyd of iron, the folution turns out of a yellow colour. It has often impofed upon ignorant chemifts, and made them imagine they had difcovered gold in different minerals, in which however there is not the fmalleft atom.

DCCLXXXIII.

The ſolution of gold in aqua regia has preciſely the ſame yellow colour with that of the oxyd of iron; ſo applying the muriatic acid, or aqua regia, and getting a ſolution of that colour, they perſuaded themſelves that they had f und gold; but finding it not poſſible to reduce it to its ordinary form, they called it volatile or imperfect gold, ſtill carrying on the impoſition, and going on with a number of experiments to extract it more fully.

DCCLXXXIV.

The vegetable acids act upon iron, and diſſolve it gently and ſlowly. The acetous acid has little attraction for the oxyd of iron; in its metallic form it produces a green ſolution. Tartar diſſolves the oxyd better, eſpecially an acid of tartar, and there are ſome particular preparations of this kind, as the martial balls, &c.

DCCLXXXV.

If theſe preparations are largely diluted, they are liable to depoſit a part of the iron in the form of a tender oxyd or mud, of a yellow or reddiſh colour, which is commonly called ochre. This depoſition we find in the neighbourhood of mineral ſprings, as ſoon as the water is expoſed to the air and attracts oxygen, a portion of the iron is depoſited, and though the quantity of this metal in a given quantity of water is very ſmall, where the water is running conſtantly it comes to accumulate at laſt: ſo water, which can be hardly made to ſhew any iron, will be made to exhibit a conſiderable appearance of ochre in the channel which the waters form.

DCCLXXXVI.

The durable yellow ſtain which the ſolution of iron, uſed in printing, gives, is owing to an oxyd. The iron, diſſolved in vinegar, is introduced into the cloth, and depoſited in the form of a powder, which cannot come out ſo long as it retains the form, until it is diſſolved: ſo the proper way of removing this is by applying an acid, to bring the iron into a ſtate of diſſolution. The muriatic acid is uſed for this purpoſe, being the moſt powerful diſſolver of the oxyds of metals, while the ſulphuric is more corroſive, and the nitric renders the oxyd more difficult of ſolution. The acetic acid does not anſwer, but the acid of ſorrel or oxalic is ſold for the purpoſe, and anſwers very well.

DCCLXXXVII.

The alkalies precipitate the iron in the form of an oxyd of a bluiſh grey colour, which precipitate attracting oxygen from the air, changes its colour, aſſuming the ordinary colour of the oxyd of iron, viz. that of an ochre. In moſt caſes it is partly, and in ſome caſes the precipitate of the iron can be wholly re-diſſolved, by adding a large quantity of the alkali. To do this, in the beſt manner, it is proper to uſe the ſolution of iron in the nitrous acid, which forms with fixed alkali the ſolution called the tincture of iron, or the alkaline tincture of iron.

DCCLXXXVIII.

The appearances of theſe preparations depend on the degree of oxydation. Upon dropping into a clear ſolution of iron a ſolution of an alkaline ſalt, there is an effervеſcence, and the iron is precipitated in the form of

a reddiſh mud; but ſtirring the mixture, it will be rediſſolved, and will tinge the fluid of a deep red colour, of as fine and rich a red as that of blood.

DCCLXXXIX.

One of the moſt remarkable effects upon iron is that which occurs in the preparation of Pruſſian blue. The iron, in its combination, appears in the form of a blue ſubſtance, the colour of which is exceedingly rich and deep, or commonly at firſt it appears of a grey or greeniſh colour, and becomes blue upon adding a ſmall quantity of muriatic acid. The moſt minute quantity of iron can be diſcovered in a mixture, by the addition of the Pruſſic acid. The iron gives an exceedingly faint yellowiſh tinge to the liquor; and dropping in ſome of this preparation, the liquor immediately aſſumes a pleaſant bright blue colour, which will be made richer and deeper by dropping into it a ſmall quantity of muriatic acid. When the experiment is made with a ſolution of iron, the mixture appears as a tincture; but there is a precipitation of the iron, as appears when it ſtands at reſt; the liquor becomes colourleſs, and the fæcula remaining is not ſoluble in any acid.

DCCXC.

The foundation of the proceſs for the pigment called Pruſſian blue was firſt the effect of accidental diſcovery. A chemiſt had emptied all his glaſſes upon the floor, and found a beautiful blue produced; and recollecting the materials, and making experiments, he diſcovered its formation: he kept it a ſecret, and made a very great profit of it. It is now a colour much valued by painters: it is uſed in preparing white linen for the market, and was firſt uſed at Berlin.

DCCXCI.

The procefs confifts in mixing equal quantities, as four ounces of fixed alkali and bullocks' blood, and the mixture is expofed to ignition in a covered crucible. By this means a coal is obtained, which is exficcated, filtered, and concentrated by evaporation. Another folution is made of two ounces of fulphate of iron and four ounces of fulphate of alumine, diffolved in a pint of water; and the two folutions being mixed, a bluifh depofition falls down, the colour of which is increafed by wafhing it with muriatic acid.

DCCXCII.

Another particular preparation which comes to be noticed here, is the effect of aftringent vegetable fubftances upon all folutions of iron, from the action of the gallic acid prefent in them. By aftringent vegetable fubftances is meant thofe which applied to the animal fibres have an effect of fhortening and hardening them, and applied to the tongue have a particular roughnefs. Thefe qualities are predominant in fome particular vegetables, as in the different parts of the oak, in the galls and leaves. We find the fame qualities in the floes, and there is a confiderable quantity of it in common tea. This mixed with iron produces a black tincture, which is fo deep that a fmall quantity of iron, and of this matter, diffolved in the fame fluid, will difcover one another, producing the tinge which is very perceptible; and this proves another nice teft of the prefence of iron in mineral waters and mixtures. To fhew this experiment we may dilute fome of the folution of iron, and then drop into it a fmall quantity of galls, reduced to powder. Thefe arife from the oak in confequence of an evaporation of the

fluids of the tree, occaſioning a protuberance. As ſoon as the aſtringent ſubſtance is diffuſed through the ſolution, a black tincture is produced, which will deſcend downwards through the fluid, till the whole acquires a black colour. When the galls have infuſed themſelves, they communicate a pale yellowiſh colour; and if the ſolution is applied to iron, it will diſſolve enough to become capable of a black tinge; and if a knife is laid upon mahogany, or other wood, and if any water, or other fluid, happens to touch it, it is common to ſee a black ſtain produced from the action of the gallic acid, which gives the black tinge. In like manner, a little of the infuſion of tea dropped on a knife will produce a blackiſh ſtain, the tea containing a quantity of this acid, which diſſolves enough of the iron to ſtrike the black tincture.

DCCXCIII.

The experiment has alſo been made the foundation of a trial for diſtinguiſhing true brandy from counterfeit. Some time ago it was required to carry a ſmall quantity of the ſolution of ſulphate of iron about with one, and to drop ſome of it into the ſpirit: if the brandy was true it acquired a black tincture; but this experiment proceeded on a miſtake that the black colour depends upon the genuineneſs of brandy, whereas it depends upon a tincture the brandy receives from the caſk: ſo it may be conſidered as a proof of old brandy. But the dealers in ſpirits, underſtanding the foundation of the black tincture, have contrived a method for eluding this trial. They prepare ſpirits, to which they give a flavour, and infuſe oak ſhavings, which give the yellowiſh colour, and the liquor will ſtrike a black colour or tincture

with the ſolution of iron, in the ſame manner as that which has received the tincture from the caſk.

DCCXCIV.

On the ſame principle has been founded the art of dying black, and the compoſition of the ink now uſed for writing. The ſtriking a black colour upon ſilk, woollen, linen, and cotton, depends upon a mixture of iron with vegetable matter, either applied at the ſame time or in ſucceſſion. In ſtaining of leather the application of a ſolution of iron is ſufficient, as during the preparation of tanning it is imbued with a quantity of the gallic acid: ſo a ſolution of iron ſtains it of a deep black.

DCCXCV.

In the compoſition of ink the chief ingredient is iron, combined with an acid, and a quantity of aſtringent vegetable matter; and as the excellence of ink and the durability of writing is a point of conſequence, and intereſting to mankind, ſeveral chemiſts have made it an object of their inquiry to aſcertain the beſt compoſition. The ingredients found eſſential to the compoſition, and to produce the effect deſired, are ſulphate of iron, galls, and gum arabic. Different perſons have different proceſſes; but the beſt proportion of the galls and iron is mixing them together in equal quantities. The ink is thus at its blackeſt colour; but in this proportion the ink does not prove durable: on being kept and expoſed to the air and light, it ſoon fades. So three parts of galls to one is the beſt proportion, producing an ink ſufficiently black, and proving the moſt durable; the durability depending upon the power of the galls which are the moſt

corruptible ſubſtance in the compoſition. The combination of the iron with the acid being little ſubject to change.

DCCXCVI.

The other ingredient, gum arabic, gives a certain degree of viſcidity. Without it the ink is ſo thin that it immediately ſinks, and ſpreads on the paper. The gum arabic gives it a proper degree of viſcidity, which limits the ſtroke, and in proper quantity it proves a ſort of varniſh; it enables us to lay on a greater quantity of ink, ſo as to ſtain the paper of a deeper colour; and upon drying it proves a varniſh to defend the black matter, juſt as oil in oil paintings defends the colours from the injuries of the air. Other viſcid ſubſtances, as ſugar have been added; but experience has ſhewn that the addition of theſe is no improvement. The ink is liable to attract humidity when the writing is put in a damp place. Reſinous ſubſtances are improper, as the water cannot diſſolve them. As ſoon as the ink becomes mouldy it will ſoon fade, the galls having begun to undergo that corruption; ſo it is of advantage that the vitriol be not completely ſaturated, the ink is paler, but it ſoon becomes black afterwards. To prevent ink becoming mouldy the addition of a ſmall quantity of cloves is of uſe.

DCCXCVII.

Having thus explained the circumſtances upon which the durability of ink depends, it is proper to make ſome enquiries with regard to an ink which might be ſtill more durable than this. One method is to prepare the paper or parchment, by ſteeping it for ſome time in a

ſtrong infuſion of aſtringent matter, and this will communicate a ſlight yellowiſh tinge, (but this is by no means diſagreeable) and the writing being ſupported by the gallic acid the paper contains, will prove more durable; but none of theſe methods of making ink can be expected to prove ſo durable as that uſed by the antients, of which we have example in the Rites of the Harlean MSS. the parts of which are ſo totally decayed, that it is impoſſible to open them out in pieces larger than the ſcales of fiſhes, and theſe little bits ſtill ſhew the writing [illegible] freſh, but they uſed charcoal for their colouring matter, which is the leaſt corruptible of any ſubſtance whatever, notwithſtanding the power of th[illegible]ry agents that [illegible]ing on [illegible] any body whatever, they [illegible]d lamp [illegible], which is an [illegible], and mixed [illegible] can be made [illegible], but it is [illegible] entirely [illegible] the [illegible], and is more eaſily eraſed. [illegible] ink we uſe penetrates into the body [illegible] paper, and [illegible] eaſily effaced; but to have an ink of this de[illegible], it is eaſy to add to common ink a quantity of [illegible] duſt of [illegible], which will have all the properties [illegible] the ink of the antients, with thoſe too of the moderns.

DCCCVIII.

With reſpect to the inflammable ſubſtances, ſulphur unites readily with iron in the way of fuſion, it penetrates iron more quickly, and unites with it more ſtrongly than with the other metals, and this metal can be employed to ſeparate ſulphur from the other metals, by applying heat; i. e. if it is in its metallic ſtate, but when we apply a roaſting or burning heat, with the action of the air, the ſulphur and the iron are conſumed, more ſo than with

reſpect to moſt other compoſitions, and the ſulphur evaporates, imperfectly burnt in the form of the volatile and ſulphureous acid, a calx of the iron only remaining.

DCCXCIX.

There is another way of applying ſulphur to iron; if we take the iron in filings, and add the ſulphur in powder, and with the aſſiſtance of water form them into a paſte, or keep them ſome hours cloſely compacted in the veſſel, the ſulphur begins to be decompounded, the maſs ſwells, becomes more bulky, and gets a drier appearance, and crumbles down in a ſort of powder of a grey colour, and, applying water, we have ſulphate of iron, a green vitriol in ſolution, or a compound of iron and the ſulphuric acid.

DCCC.

This effect of iron and ſulphur enables us to underſtand the operation by which the common vitriol is manufactured. It is prepared by a proceſs affording it much cheaper. The materials are a natural compound of iron and ſulphur, a ſpecies of the pyrites. What anſwers the purpoſe is generally found in the neighbourhood of coal pits, in flattiſh maſſes, generally lying in the ſame bed parallel to the coal, and forming a thin interrupted ſtratum. This has pretty much the ordinary appearance of the pyrites, it has a granulated kind of texture, and has frequently a maſs of coal adhering. When expoſed to the air, it undergoes the ſame change which an artificial mixture of ſulphur and iron does; it gradually [illegible] the ſurface is covered with a whitiſh downy efflore[illegible]nd when examined more narrowly, conſiſts of oblong chryſtals of ſaline matter. By length of time the whole of

the mafs is refolved, and upon applying water, all but the chalky matter is diffolved: the liquor it affords is found to be a folution of iron in the fulphuric acid, but containing an over proportion of acid; it is of a yellowifh colour, or reddifh, and has fome degree of vifcidity, or an oily or unctuous appearance when evaporated fuddenly, it being confiderably diluted and requiring evaporation. It does not afford chryftals, but an unctuous matter, which attracts humidity. To obtain good chryftals we muft infufe into it pieces of old iron; the liquor is warmed to make it act more readily in a large leaden refervoir, which though corroded by the acid, is not diffolved. The furface of the lead is foon covered with a thin cruft of oxyd of lead, faturated with fulphuric acid, and not being foluble, it preferves the reft of the metal from the action of the acid; the liquor is kept warm, and towards the fides they place pieces of old iron till it is fufficiently faturated with metal. It is then run off and cooled, when it chryftallizes on the furface, and on fticks put in for the purpofe.

DCCCI.

The manner in which the liquor is obtained in the common procefs, is by expofing it in beds in a field adjoining to the houfe. Thefe beds confift of clay foil, and their bottom is laid with the toughest clay they can get: the pyrites is taken out of the coal-pits and fpread on thefe beds, and by the influence of the air it is decompofed. It is conveyed by a gutter into a ciftern in the floor of the houfe, out of which it is pumped into a leaden ciftern, in which it is faturated with iron.

DCCCII.

There seems to be something in the nature of the composition of the pyrites which is fit for this process. This knowledge of the nature of the pyrites, and of its decomposition, has been the foundation of some theories and opinions, with respect to some of the most striking phænomena in nature, as earthquakes, volcanoes, hot springs, &c.

That many of these phænomena derive their origin from mixtures of iron and sulphur, from large collections of the pyrites, which exposed to the action of the air and humidity, suffers this resolution, and in consequence of their great quantity, that great heat and exhalation of a great quantity of inflammable vapours, these phænomena are produced What has further supported this idea is, that something resembling these can be produced artificially, if a considerable quantity, as 30lb. is mixed into paste, and buried at a moderate depth, in some hours an elastic vapour is produced, which begins to raise the ground a little, and from the irregular manner in which it rises, it gives it a shaking and trembling motion, and afterwards breaks out and takes fire, resembling the phænomena where there are subterraneous fires.

DCCCIII.

From the experiments made to examine the nature of iron in mixture with other metals, it appears disposed to unite with them all, except lead, and there are none which dissolves it more readily than gold. When gold in fusion is stirred with an iron rod which is pure, and not containing sulphur, it is dissolved, and they unite readily.

It is difficult to make it combine with mercury, though

in certain circumstances they can be made to act upon one another, the iron loses its toughness Thus springs exposed to the contact of mercury become perfectly brittle.

It is difficult to unite iron with [illegible], on account of the volatility of the latter.

It has a strong attraction for antimony and arsenic, and deserts many other substances to unite with them.

Iron, though mixed with any other metal, is still attracted by the load stone, except when mixed with antimony, which changes its nature in that respect, so as to render it incapable of being attracted.

DCCCIV.

Steel is nothing else but iron combined with carbon. It is done by a sort of cementation; the iron is prepared by being made into bars of a moderate thickness, that the cementing matter may penetrate them. The materials which are applied, are charcoal dust, or that mixed with a small quantity of soot, and with some common salt; sometimes with some vegetable ashes. These are put into vessels in the usual manner, as in cementation; first, they put in a quantity of the mixture in powder, over this some of the iron, then more of the mixture, and so on alternately, till the vessel is full, and the mouth of it accurately closed: thus, if the steel is made in a crucible, we can shut it up by inverting another crucible, and closing the joint perfectly, which is the most compleat manner of shutting a crucible; the whole is kept heated to a pretty bright red, and when taken out the iron is found converted into steel.

DCCCV.

The changes it has undergone are these; It is said to receive a small increase of weight; it is also more fusible.

it can be brought into a perfect fusion, which iron in its ordinary tough state is hardly capable of. It is more difficult to form under the hammer; it must be heated to a moderate degree only, and managed more gradually; for with violent strokes, or when strongly heated, it is liable to fly in pieces: thus the forging of steel is more difficult than the forging of iron: it is somewhat less ductile; when a piece is broken across, the internal texture is different from that of iron; a bar of iron has a rough surface, or rather with fibres or pointed particles which are prominant; a surface of steel has a number of shining plates, so that it appears altogether of a granulated texture.

DCCCVI.

But its principal change when converted from iron into steel, is its very great hardness, the very strong cohesion of its parts, and the great degree to which this can be increased by the temper; in this respect, the softest steel is far superior to iron; and, in consequence of the great hardness it can be made to assume, and the different degrees of it, all kinds of tools are made of steel, which not only cut iron with ease, but steel itself in its softest state. To temper it they heat it to a pretty strong red, and they know the proper degree by the look, and in that state it is cooled as quickly as possible, by plunging it into cold water; it is then extremely hard, it will mark glass like flint, and a file does not produce the smallest effect upon it. This is attended with a great degree of brittleness, the extreme hardness being attended with the total absence of flexibility; but the workmen can diminish this hardness, and communicate flexibility to any degree which they please, and by a very simple and easily managed process, they need only to heat it again; and if this

is done to the ſame degree as before it was changed, it is perfectly ſoft again: if they want to ſoften it only to a moderate degree, they muſt heat it leſs than this, and ſtop the heating of it as ſoon as it is brought to the due degree, by plunging it into water again, and the different abatements on different occaſions can be judged of by the colour appearing on the ſurface, produced by a thin film of oxydated matter. 1ſt, An orange yellow, or golden colour, then a purpliſh colour comes on, then this is ſucceeded by a blue, which ends in a violet: if they heat it till it acquires only the orange colour, and then ſuddenly cool it again, it will have acquired a ſmall degree of toughneſs, with a great degree of hardneſs, the greateſt degree which is requiſite for any tools.

DCCCVII.

The ſteel inſtruments uſed in coining are tempered to this degree; other inſtruments are hardened nearly to the ſame degree at their points; others uſed for cutting iron are ſoftened more; others made for cutting wood are made to aſſume the blue colour, which is attended with ſuch flexibility as to prevent the edges, or points, from being eaſily broken.

DCCCVIII.

With reſpect to the qualities of ſteel, they are the ſame in all kinds of mixtures, only it is not ſo eaſily diſſolved, and it does not ruſt altogether ſo ſoon. It is more fuſible too, and one of the greateſt improvements made of ſteel is the fuſion of it, by which all the parts of it are blended together and made more uniform; and any heterogeneous ſubſtances are thrown to the top, in the form of

scoriæ. The best steel (so much valued) is made in this way, by melting pieces of steel together.

DCCCIX.

With regard to the ores of iron, and the manner in which it is extracted, no metal is found more plentifully, but it hardly occurs in its metallic form, or free from admixture: in general, it is found in the state of a calx or oxyd; and it is very often intermixed with a certain proportion of sulphur.

The minerals wrought for iron are three, called iron ore, iron stone, and bog ore.

DCCCX.

The iron ore is found in veins as the ores of other metals are, and the appearance is very various, sometimes it has a rusty colour, resembling that of iron, sometimes it has a reddish cast; often it is formed into a kind of chrystallizations, which are protuberant knobs on the outside, and these consisting of fibres tending to a common centre, and often it is of a dark colour, like coagulated blood, and is called hematities or blood stone; it consists of an oxyd of iron with a small quantity of sulphuric acid.

Iron stone in Scotland is clay, found in strata with coal, but which contains a large quantity of iron, so as to render the working of it profitable. Sometimes it has little appearance of iron; but when burnt with a certain degree of heat, it becomes of a deep red.

DCCCXI.

The bog ore is an ochre, or oxyd, of iron, and is generally found in low situations, and in springs containing a small quantity of iron, which, flowing over the grounds, deposit it in the form of ochre; and, after a number of ages, it

proves a rich mine of iron, and is extracted from an oxyd of this kind in many parts of the world.

Besides, it is found chrystallized in a number of different forms, preserved in the cabinets of the curious. And the ores of most other metals contain more or less iron, as do also all the coloured clays and boles, the earths and precious stones, as the granite, &c.

DCCCXII.

The ashes of vegetables contain iron, and the different parts of animals, as the blood, milk, flesh, have been found to contain a small quantity. When these substances are kept red hot with inflammable matter, upon applying the magnet a number of particles fly to it. So there has been a dispute, whether the iron was preexistent in these substances, or was produced during the destruction of these substances by heat; but it abounds every where, and we can easily imagine how it should pass into the composition of vegetables, and from these into animals.

DCCCXIII.

But fossils of iron are useful on other accounts, as the active red and yellow ochres, which are used as pigments; some of them are of a fine red and yellow colour, and are very durable.

Red chalk is a kind of clay containing a large proportion of iron. There is a particular kind of spar found in many parts of the world, of a pale blue colour, so that from its first appearance we should expect copper in it, but it contains a small quantity of iron, as in the Prussian blue.

Similar to this, in the hard stone called emery, which

affords the powder employed for grinding other ftones, is contained iron combined with the flinty earth.

DCCCXIV.

The loadftone is a noted ore of iron; it is always found in veins; and it is alledged that it is only poffeffed of its magnetic qualities when near to the furface. In appearance it does not differ from many of the ores of iron, and heated as an ore, it affords a confiderable quantity of it.

Though the ores of iron are thus plentiful, yet only the richeft of them are wrought; if they contain too much fulphur they cannot be wrought with advantage, the fulphur adhering ftrongly, and giving a bad quality to the iron; and if there is much earth, the ore turns out fo infufible that it requires much fuel, and the yield of metal is too fmall to compenfate the expence.

DCCCXV.

It is ufual to roaft the ores of iron containing fulphur, or fulphuric acid, which are thus expelled, then they are melted in a large furnace, which is now made of a much larger fize than formerly, and a quantity of lime is added, in order to bring the ore into fufion, and fome have fuppofed that it attracts a part of the fulphur, efpecially the common ore melted in this country, called iron ftone, having much clay and fandy matter, it requires the addition of lime. Some time ago it was thought neceffary to ufe the charcoal of wood, and for pure bar iron and tough iron it is neceffary; but for cafting, the iron can be obtained by means of pit coal charred, which is much cheaper; as firft run down from the ore, it has not all the qualities of iron, but the external appearance and internal qualities are different; it is of a light blue, and when

broken, it is of a dull white, approaching to polished silver; the fracture is smooth, and of a crofs and uniform texture: it is not a solid mafs, but confifts of a number of chryftallizations, which are branched and figured, and which leave fmall interftices, making it impoffible to give it a fine polifh The microfcope fhews that it confifts of plates like thofe of the brittle metals, though not fo obvious. It is, likewife, very hard, yields little to the file or chiffel, and has not the leaft malleability, or flexibility; it readily breaks upon being bent, and it is liable to melt by fudden heating or cooling, and it is not fo liable to ruft and diffolve as iron brought to its moft flexible ftate.

DCCCXVI.

Some kinds of caft iron are fofter to the file, and have a degree of toughnefs, but thefe are not the pureft; they do not contain the greateft quantity of pure iron in the refining furnace. The iron in this ftate, is called pig iron; it is caft into oblong bars, called pigs. It acquires the malleability and toughnefs of iron, by the operation called forging. A confiderable quantity of it is heated on a hollow forge covered with charcoal of wood; the heat is raifed till the iron is gradually melted, and it is kept in this heat, and the bellows blown upon it, fo as the wind is directed on the furface of the metal; in this way a quantity of it is converted into droffy fcoriæ, which are let out by a hole in the fide of the forge, and by the continuance of the operation the iron forms an irregular cavernous and fpongy mafs, which is fubjected to the action of a large and heavy hammer wrought by a wheel, which compacts it into a thick fquare lump, the parts of which are imperfectly united, but upon heating it again it be-

comes soft, tough, and malleable, so as to be drawn out, by the action of the hammer, into bars. In this state it is composed of fibres. When we put it into any weak solvent which will act more readily on the soluble parts, it appears manifestly to be divided into fibres.

DCCCXVII.

With regard to the nature of the change it has undergone, it loses a quantity of dross, mostly of an earthy nature, and it may lose half its weight in this way, and likewise its carbon and oxygen uniting are expelled. Thus iron before this possesses a quantity of earth and oxygen, and where the former predominates, it bears some resemblance to steel: they are both hard and inflexible they have the same texture, and agree a little in colour, being both whiter than tough iron, and they are both less liable to rust. If steel be cemented by the same materials, it comes to be overcharged, so as to be like cast iron, it is incapable of being forged, unless it is exposed to the action of heat and air, to dissipate a part of its carbon and oxygen, it cannot otherways be welded; and the purest kind of cast iron, melted and forged to a certain degree, becomes steel; and we are likewise told, that steel is made in this way in some places of Germany, though it is not of so equal a texture.

DCCCXVIII.

There is a further experiment which throws light upon the subject. It is a process described by Pliny, and followed by the antients, to convert iron into steel. They plunged it into melted cast iron, and kept it there some time, when it was changed into steel; so cast iron contains something which converted it into steel. It contains

carbon or the principle of ſteel. So Reaumeur tried if the ſame cementation had the ſame effect on caſt iron, and he found his experiments to ſucceed. When iron is cemented with bone aſhes, from the phoſphoric acid it returns to the ſtate of ſoft iron, and is called cold ſhort iron; caſt iron heated in the ſame manner likewiſe acquires the ſame qualities. This is an art worthy of cultivation, that the iron in its brittle ſtate may be caſt into any mould, and then by cementation be converted into tough iron, whereby the fine and delicate parts would not be ſo liable to be taken off by the ſmalleſt accident; and this might be brought into practice as an art. Thus a proper cement will convert the external parts into tough iron, while the internal parts retain their fuſibility; ſo that in this way, a cannon-ball might be reduced to the form of a ſhell: this is an improvement in ſome of the works made of this metal, that a great part of the metal may run out, ſo as to make them lighter and ſave a part of the metal. We next proceed to conſider copper.

DCCCXIX.

Copper.

The obvious qualities of this metal are well known; it is more ductile and malleable than any of the metallic ſubſtances yet deſcribed, ſo it is a more perfect metal. It is next to iron in hardneſs and ſtrength, not being ſo eaſily inflammable, and not ſtriking fire with hard bodies. It is uſed in place of iron for their hammers, &c. in gun-fire works. It has a paliſh green colour, in conſequence of fuſion. It is obſerved, that this metal does not bear to be melted, and it is difficultly caſt ſolid; unleſs it is heated ſtronger, it forms a metal which has not a proper degree of toughneſs; and if it is over-heated, a number of air holes is

produced; ſo, in caſting cannon, it is neceſſary to add other metals, as zinc, or braſs, to increaſe its fuſibility. Another particular in the melting is, the great danger attending the approach of watery humidity, the violent exploſion thereby occaſioned, often totally demoliſhing the works in which the metal is caſt. This is particularly owing to the great heat it acquires in its fuſion, and partly to the great quantity of heat it contains when heated to a great degree, in which it exceeds every other body. There are ſome operations which require the copper to be reduced to ſmall grains, or particles, which is done by pouring a quantity of water upon it in its melted ſtate, but they are obliged to take every precaution to prevent the conſequence of theſe exploſions. A cavity is ſunk in the ground, over which is placed a cover, which is very ſtrong, with thick bars, or plates, of caſt iron, and the copper is made to run into the water with a very ſmall ſtream: it produces violent exploſionss which ſhake the ground, and even ſometimes burſts the apparatus in pieces.

DCCCXX.

When we calcine the metal, it is beſt done in a heat inferior to its fuſion. It is ſoon covered over with a duſty cruſt, which flies off its ſurface when bent. This kind of calcined matter is produced in conſequence of its abſorption of oxygen, and it eaſily returns to malleable copper again.

It ſtrongly reſiſts the injuries of the air and humidity. It acquires an obſcurely gloſſy ſkin, or oxyd, which defends it like a varniſh.

The ſaline ſubſtances act upon it with great facility, the more ſimple ones diſſolve it, and the more weak corrode it.

'he ſulphuric acid requires the aſſiſtance of heat, and to be applied ſtrong, which oxygenates and diſſolves it, forming a ſolution of a pleaſant blue colour, and this being evaporated, very eaſily affords chryſtals of a pleaſant and tranſparent blue colour when freſh, and are known under the name of blue vitriol, or ſulphate of copper. The manner of manufacturing this is not by uniting pure vitriolic acid to copper, except in particular caſes, when it is done with a different view, as in ſome places where large quantities are manufactured in thin plates, which are gilded; theſe are diſſolved again into ſulphuric acid, in order to ſeparate the gold. But the common manner of obtaining it is from the copper of pyrites.

DCCCXXI.

The action of the nitric acid is in no way particular; it diſſolves it as uſual, which is experienced by the diſengagement of much nitrous gas, and the ſolution turns out of much the ſame colour as that by the ſulphuric acid, a very fine blue and green colour being produced, according to the ſtrength of the acid. By evaporation it may be reduced to the form of chryſtals, being nitrate of copper, but they are ſtrongly deliquieſcent. The action of this ſalt is peculiar upon tin.

DCCCXXII.

The muriatic acid acts only upon it, boiling and concentrated; it produces a green colour, of a different tinge, ſometimes a pleaſant graſs colour, ſometimes a darker colour, like that of fading vegetables, according to the concentration of the acid, or the muriatic acid may be united to copper by the medium of muriated mercury, forming a dry ſubſtance which melts with a gentle heat, like the

plumbum corneum, and melts like rosin. The compound is volatile, and tinges the flame of a candle green. This is observed in many of the preparations of copper; for even the copper reduced to fine filings, and thrown into the flaming fire, tinges the flame of a blue or green colour.

DCCCXXIII.

When copper is dissolved by the acetic acid, it gives a green of a different tinge; the solution being evaporated, affords chrystals of a dark green colour, which give a powder of a bright and pleasant green. These are known to the painters, under the name of distilled verdigrease, or cupricum acetatum, but improperly; the reason is, that they are produced by distilled vinegar, in which copper is dissolved. To do this, we must not only apply it in its metallic state, but we must take it in the form of a rust, or oxyd, produced by means of the vegetable acid itself. This is known by the name of verdigrease; it is of a pale bluish green colour, it is prepared in large quantity from the husks of the grape; after the juice is squeezed out there remains a fermentable matter, capable of acquiring acidity; this is put into earthen pots in alternate layers with plates of copper; and these are arranged in rows on a dunghill with horse dung, by which the fermentation is raised, and an acetic acid produced, which rusts or oxydates the copper; and the plates being bent, the rust or oxyd is struck off, brings verdigrease. This is dissolved easily in distilled vinegar, tinging it of a greenish colour, like that produced by the muriatic acid; and from that solution the chrystals, called distilled verdigrease, are obtained.

DCCCXXIV.

Those combinations of copper with acids can all be decomposed; that with the sulphuric acid can be decompounded by means of heat, though with difficulty, it requiring a violent heat. The compound with the nitric acid is more easily decompounded; that with the muriatic acid more difficultly, as it adheres to the copper and volatilizes a part. The most easily decompounded is that with the vegetable acid, which retains it so slightly, that heat alone will totally expel it; and in this way we have an opportunity of reducing the vegetable acid to its greatest degree of strength, we can bring it into a dry form, we can evaporate the whole of the water by applying heat, and raising the acid in vapour, the copper remains behind, not retaining it so strongly as to occasion its being exposed to a red heat, as when it is combined with a fixed alkali in the sal diureticus, &c. which retains the acid till the heat totally destroys it, but with the copper the acid is separated sooner, and we have it in the greatest degree of strength, and it is called concentrated spirit of verdigrease.

DCCCXXV.

Besides the effects of heat in decompounding these combinations of copper with acids, we can take the assistance of additions; we can add substances having a stronger attraction for the acid, as the alkalies and absorbent earths. All of these occasion a precipitation of the copper; the absorbent earths precipitate it in the form of a powder of a light and pleasant blue, a portion of it being deposited in the earthy particles. It is used by the painters under the name of verditure.

DCCCXXVI.

The alkalies precipitate it like verdigrease, but the quantity of the alkali being increafed the copper is re-diffolved, and produces a rich and beautiful blue. The moft remarkable precipitation and re-diffolution is by the ammoniac. The blue produced is fo extremely rich, that a very minute quantity of copper becomes vifible in a large quantity of water. It is faid that $\frac{1}{16}$ part of a grain of copper will be eafily detected in a pint of water.

DCCCXXVII.

The colour produced by the combination of the ammonia with the metal can be again deftroyed, and reproduced; and by adding an acid and alkali alternately, the colour appears and difappears as often as we pleafe. So the deep coloured rich blue folution is a compound of the ammonia with copper, and it is only when the ammonia prevails that the deep blue folution is produced.

DCCCXXVIII.

There is a preparation in the fhops called aqua fapphirina, which is made by putting into a brafs mortar fome lime water with a little muriat of ammonia about 24 hours, the lime water decompounds the muriat of ammonia, and the ammonia acting on the copper, the folution acquires a light blue colour.

DCCCXXIX.

There is at prefent made ufe of in medicine a compound of copper with ammonia in this way, which is thought to have virtue in the cure of the epilepfy. It is prepared

from blue vitriol; the procefs recommended is, to prepare it from this diffolved in water and filtrated; to this is added a quantity of ammonia, fufficient for precipitating the copper and afterwards rediffolving it. When the ammonia is added to the filtrated folution, it effervefces, and precipitates the copper fo copioufly, that the mixture becomes quite thick at firft; but repeating the addition of volatile alkali, we gradually faturate the whole, and rediffolve the copper; in doing which we muft take care to agitate the liquor, and to obferve if any oxyd in the form of white particles remains undiffolved. There is no danger in adding too much, the following part of the procefs will diffipate this: what remains to be done when the copper is completely diffolved is, to pour the liquor into a china plate, and fet it before the fire, or in a fand heat, not much above that of the human body. It foon evaporates, fo as to leave a cruft of faline matter, containing the two compounds of ammonia, with fulphuric acid, and the alkali with the oxyd of copper. It is this latter compound which is efficacious, the other neither does good nor harm; but as the efficacy of the preparation depends on the combination of the copper with the ammonia, the moft gentle degree of heat muft be ufed, otherwife the ammonia is feparated from the oxyd of the copper, and it is proper to fcrape it together, to grind it to a powder, and clofe it up in a vial, when it forms a powder of a deep blue colour.

It is likewife obtained in a folid form by mixing 3 parts of carbonate of ammonia with 2 of fulphate of copper. This forms a compound, known by the name of the ammoniated fulphate of copper.

DCCCXXX.

When the calces of copper are mixed with earthy ſubſtances, they give them a tinge like that of their ſolutions with acids, giving blues of different ſhades.

Sulphur unites ſtrongly with copper, forming a lead-coloured maſs, not eaſily decompounded again. Though iron has a ſtronger attraction for ſulphur, the copper has the property of retaining it more ſtrongly; ſo that when theſe two metals are expoſed to heat, the iron is much more diſpoſed to be oxydated, and conſequently to loſe its attraction for the ſulphur, as the ſulphur does not unite with the oxyds of metals.

DCCCXXXI.

Some other inflammable ſubſtances act upon copper, as the aromatic and rancid oils, and oil of turpentine and tallow, when rancid from the preſence of the ſebacic acid, they diſſolve a ſmall portion of it ſo as to be tinged blue or green; and, in ſhort, this metal is ſo liable to the action of ſolvents, that it is remarkable in this way.

DCCCXXXII.

The moſt uſeful compounds of this metal are the combinations of it with zinc, which compoſe

Braſs, bearing a greater or leſs reſemblance to gold. The manner of making it ſhall be taken notice of: with a certain proportion of arſenic it receives a white colour, and forms a compound metal, called tutenag, which is manufactured in this way with arſenic and braſs; with a ſmall proportion of tin it is hard and elaſtic, and conſtitutes bell metal, the mirrors of teleſcopes, and burning concave mirrors; it is alſo added to the more precious metals, gold and ſilver, and it is the only metal which can be mixed

with them, without deſtroying their ductility; a ſmall quantity of it gives them more firmneſs and hardneſs for the formation of different veſſels.

DCCCXXXIII.

The relation of lead to copper is particular; it does not unite with the copper unleſs it is very hot; unleſs it is brought to its boiling heat, when it ſcorifies, then the copper unites with it with rapidity, but allowed to cool, by the time the lead congeals the copper ſeparates, and again chryſtallizes into a number of fibres, while the lead cools into a number of little particles throughout the maſs, but does not intimately combine with it, we ſee the lead and copper ſeparate from one another. In conſequence of this, lead is readily ſeparated from copper, if the maſs is heated in ſuch a ſituation that any melted matter may flow from it, as by placing it on an inclined plane in a certain degree of heat, the lead ſweats out of the pores of the copper, the copper remaining in a ſpongy maſs; ſo it is uſed to ſeparate ſulphur from copper, which it does moſt effectually. It is ſeparated from the other metals by many different proceſſes, according to the nature of the metal.

DCCCXXXIV.

The ores of this metal are met with in all parts of the world; but the moſt remarkable are found in Sweden, Hungary, and Tranſylvania. Such an ore may be known by a green or bluiſh colour about it. Specks are perceivable in the ſurrounding ſtones, or on the ſurface there is a green powder like verdigreaſe diſſipated from it. If there is any doubt, it is eaſily known, by putting a ſmall quantity into a veſſel, and dropping into it ſome drops of

ammonia, immediately it is dissolved, and produces the deep and rich blue colour. There are some blue ochres which derive their origin from iron, which are not thus dissolved. The copper sometimes occurs in the veins in its metallic state; and it is the first of the metals which is thus found by nature. Tin, antimony, and even iron, occur in their metallic state, but exceedingly rare; but copper is thus found frequently intermixed with the stony matters of the vein, and such stones are of a reddish colour from the small particles of copper, the copper uniting into exceedingly fine filaments, much finer than hairs. A particular kind of copper is found in moors and bogs, formed by the deposition of that metal, or vegetable inflammable substances, which these bogs contain, and this is also in its metallic state, but it is much more frequently found in the state of an ore combined with sulphur, and generally with some arsenic, and it is seldom free from both these substances, and also from a portion of iron.

DCCCXXXV.

The ores may be arranged into three divisions. 1st. A pretty pure oxyd of the metal united with a small quantity of sulphur, arsenic, or iron. This appears in different shades of green or blue, sometimes of a very deep blue, and forming a sort of chrystal, which is called the minera cupri vitrea; they give the name of vitrea to the richest ores of metals: sometimes it is of a green colour, like verdigrease, called minera viridis. It is generally mineralised (to use the common term) by combination with sulphur or arsenic, which melts with it in this state in different degrees of purity; when there is but little iron it constitutes a grey copper ore of a dark colour, duller than that of lead; sometimes it is purplish when it is fresh

broken interfpered with fpar and a flinty matter, called the minera cupri lazuria.

DCCCXXXVI.

Another kind of it, which is more common, (and from its plenty is highly valued,) is the copper pyrites; it contains more iron than copper, but the copper is valuable, and fo it is wrought on account of the copper. Here it is combined chiefly with fulphur, and a large proportion of iron. This kind of pyrites is eafily diftinguifhable from what is commonly called the iron or fulphur pyrites, which contains norhing elfe than fulphur and iron. The iron pyrites are very hard, fo as to ftrike fire with fteel, but the copper pyrites are never fo hard as this, the point of a knife makes no impreffion upon them; befides the colour is different, the copper pyrites is more yellow, approaching to that of gold, and the fractures of it have the different fhades of the rainbow colours upon them. In fome parts of England there are great quantities occurring, chryftallized on the furface of fpars, which make a fhining appearance; the metallic matter is attended with a tinge of the rainbow colours.

DCCCXXXVII.

With regard to the extraction of copper from thefe ores. When it is in its metallic ftate it needs only be refined, the fulphur or iron requires to be feparated by melting it in a hollow forge, in which the heat is raifed by fuel on the furface of the metal, the air thus promoting the fcorification of the more deftructible parts; fo the iron and arfenic, as being more deftructible and volatile, are fcorified and taken off to afide, till the copper is at leaft fufficiently refined. This operation is practifed more fuccefsfully, if a quantity of lead be added, which promotes

the ſcarification of theſe more oxydable ſubſtances, and leaves the copper pure and fine. It is true, that when lead is employed, a part of the copper is ſcorified, lead having great power in promoting the oxydation of other metals; but it has little of this effect upon copper. In Sweden, where large quantities are manufactured, they have a particular manner in taking it out of the furnace. The furnace is conical, contracting in the bottom, and is lined with a lute of charcoal duſt and clay, when the copper is refined, which they know by dipping into it the point of an iron rod, to which the copper adheres, they then clear away the fuel and ſcorified matter, and begin to take out the metal; but as the quantity is very great, it would require a long time to cool of itſelf, (and it would be impoſſible to take it out of the furnace,) ſo they pour a ſmall ſtream of water upon the ſurface, which flows round the metal without touching it, as mercury upon wood; for the water being warmed before, the great heat of the metal converts it into vapour, ſo that there is always a vapour interpoſed, which prevents them from coming into contact, but the water evaporates firſt, and occaſions a conſumption of the heat of the copper, and a cruſt of it is hardened, which is raiſed up by means of an iron lever, and removed, a freſh ſurface being congealed in the ſame manner immediately after, and this is repeated till the whole maſs is taken out. Theſe cruſts are laid on the floor one over another; they become gradually narrower, forming a pyramid, or cone; when taken out in this manner, it is called roſe copper, having a bright and rainbow colour on the inſide, and a roughneſs (making it bear a reſemblance to a roſe expanded,) and the copper in that ſtate is reckoned extremely fine.

DCCCXXXVIII.

If the copper is found in the state of an oxyd, the operation is very simple. It is reduced to its metallic form, and the copper obtained by refinement: but where it is combined with sulphur and arsenic it costs trouble and repeated operations, (these substances adhering strongly, as does also a quantity of iron, which seldom fails to be present.) These ores are treated by repeated roastings and fusion; every time a quantity of the sulphur and arsenic evaporates, and the iron is scorified. The iron, without the presence of these, would be difficultly separated, but the sulphur and arsenic favour the oxydation of the iron, so that it can be converted into scoriæ, while the copper is not so subject to this scorification; so these volatile substances are gradually dissipated, and at last the copper turns out pure, but it is never so pure as when a quantity of lead is mixed, or added to it, in order to promote its refinement. There are some of the ores which are so very impure, that it is hardly possible to extract it even by water in the way of solution.

DCCCXXXIX.

Manganese.

Manganese is a metal of a grey white colour, soon decomposed by exposure to the air, by which its surface becomes oxydated. It is very generally diffused both in the earth in various forms, as also in the ashes of different vegetable products.

The native oxyd is its most abundant ore, and from its different degrees of oxydation, it varies in colour, texture, and form: but it has commonly an earthy texture, and generally a brownish or bluish black colour.

This oxyd is difficultly reduced to the metallic state,

and it can hardly be obtained but in small globules, which, on exposure to the air, lose their colour, and fall at last into a black powder. This is the consequence of oxydation, and it is very quickly effected on them with the assistance of heat, though at a low temperature.

Two principal species of oxyd of manganese are found, the white and the black. The former is the oxyd in acids precipitated by alkalies, the latter the same oxyd exposed farther to the action of heat, and intermediate gradations are occasionally produced.

The former of these possesses the strongest attraction to oxygen of any metal whatever, but the increased quantity in the latter is separated by the temperature of ignition.

These two oxyds also clearly prove that solubility in acids only takes place in a certain degree of oxydation. Thus the white oxyd is soluble in all acids, while the black remains undissolved in the sulphuric and nitric acids, unless an inflammable matter is added to remove part of its oxygen, but it dissolves in the nitrous and sulphureous, a confirmation of the same fact, but it combines readily with the muriatic acid, and oxygenated muriatic acid is formed.

DCCCXL.

The sulphat of manganese is soluble in water, and chrystallizable. The nitrat and muriat remain always soft and deliquiescent; they are decomposed by the alkalies, and a white precipitation ensues. The fixed alkalies combine with the black oxyd. This combination is formed by exposing it to a strong heat in a proportion of one part to two of the salt. The compound dissolved in water varies in its colour, and turns from green to purple, and then to

red, and the addition of nitric acid renders it colourleſs, ſo it is termed the mineral chameleon, or alkaline oxyd.

Manganeſe is incapable of combining properly with ſulphur, though eight parts of oxyd with three of ſulphur form a maſs of a greeniſh yellow colour. It combines with phoſphorus, forming a white metallic compound. It poſſeſſes likewiſe an attraction to carbon. Its combinations with the other metals are at preſent little known. Its ſtrongeſt attraction ſeems to iron.

The oxyd unites by fuſion with the earths, and thus, from its uſe in glaſs-making, termed glaſs-makers' ſoap. In a large quantity it gives a violet colour to glaſs: in ſmall quantities, if uſed to glaſs diſcoloured, by coally particles on iron it renders it colourleſs. It gives the black glazing to pottery ware.

DCCCXLI.

Arſenic.

This metal in extracting it from its ores is commonly procured in the ſtate of a white oxyd. It is diſtinguiſhed from every other metal by its volubility, and when heated with the acceſs of atmoſpheric air it is eaſily oxydated. In the temperature of ignition it burns with a blue flame, and emits an alliaceous ſmell. This oxyd has a ſharp cauſtic taſte, is ſoluble in water, and in boiling water its ſolution, on cooling, affords chryſtals; by farther oxydation it is completely acidified.

The white arſenic of commerce, or imperfect oxyd, is hardly diſſolved by ſulphuric acid. Nitric acid by its communication of oxygen acidifies it; the nitrate is, therefore, hardly to be obtained. The muriatic acid diſſolves

it with facility, and two varieties of combinations with this acid are formed, differing in their degrees of oxydation.

Oxygenated muriate of arfenic is concrete of a foft confiftence, and is decompofed by water.

Oxyd of arfenic combines with the fixed alkalies, and alfo their folutions in an increafed temperature: this faturation is thick, tenacious, and emits fumes of arfeniated hydrogen. Ammonia and lime water alfo diffolve a part of the oxyd.

Acid of arfenic is attained by the diftillation of white oxyd in nitric acid, the refidue remaining on the difcharge of the nitrous gas, is the acid in a concrete form. It is foluble, in twice its weight of water diliquiefces, and fhews the teft of an acid by reddening turnfole, and has a cauftic tafte. The acid combines with the alkalies, and forms, by folution and evaporation, fome falts which are little known.

DCCCXLII.

With regard to the earthy fubftances, their vitrification is haftened by it; and it is found an ufeful compound, or addition to glafs, the greateft confumption of it being in this way. It is a common practice to plunge a piece of it tied to the end of an iron rod, to the bottom of the pot, which quickens its refinement and clarification, the alkali which the glafs contains fixes the arfenic, which diffufing itfelf through the glafs, increafes the tenuity of its fufion, but the glafs then made foon tarnifhes.

With the inflammable fubftances it unites with fulphur into a compound, or fulphuret, that is more fufible than the arfenic, and that in proportion to the quantity of fulphur. Some of the compounds can be melted eafily into a perfect fluid, and the colour varies according to the propor-

tion of ſulphur. When a ſmall quantity of ſulphur is combined the colour is yellow, and it forms orpiment; and when the proportion of ſulphur is large, it is of a deep red colour, and forms a powder which is called red arſenic, or realgar.

The poiſonous quality of the arſenic is very much abated in this compound, as is the caſe with other mineral ſubſtances that have a great power over the human body, as antimony and mercury; they may be ſeparated by adding a ſmall proportion of alkaline ſalt, and ſubliming the mixture.

Phoſphorus combines with arſenic, and forms a compound of a black colour and metallic luſtre, oxydated by the air.

DCCCXLIII.

The relation of arſenic to the metals remains to be conſidered; it unites with the whole; it is applied in the way of cementation mixed with charcoal duſt, or black flux; the metal is beat into plates, and interſperſed with this mixture in a crucible; its effect upon the metals is to give them a white colour and to render them brittle; no mixture of this kind has been found uſeful, except that of copper. It communicates ſome degree of a white colour to it, ſo that approaches to ſilver, and it is called French plate, but is attended with a yellowiſh caſt; this, however, does not appear in candle-light.

With regard to the origin of arſenic, it is found pure in a grey powder, or contracted into a ſolid ſubſtance, but pure arſenic is a very rare mineral; though in the ſtate of combination there is plenty of it. It abounds in a great many of the ores of lead, and in a compound of iron called

white pyrites, having a whiter colour than the pyrites of iron and sulphur; when these are struck, they give out an odour resembling that of garlic; but the ore containing it in the greatest quantity is the cobalt.

We meet with native compounds of arsenic with sulphur: they resemble the artificial compounds, only they are of a foliated texture, placed between the eye and the light they appear transparent like the artificial compound, and assume the same appearance when melted.

DCCCXLIV.

The greatest part of the arsenic found in the shops, or made use of in arts, is obtained from the ore of cobalt, the oxyd of which tinges glass of a deep rich blue colour, so is employed for the decoration of china and other earthen ware. The arsenic in this ore is in its metallic state, and evaporates freely when red hot; the cobalt is heated in a large furnace in the form of an oven; at one end there is a place for a fire, and in the other a vent drawn off in the form of a gallery, through which the smoke and steams pass a long way before they are allowed to escape, and the condensible matter is allowed to condense, workmen are put in to collect it, and the matter is found to be arsenic, the metallic part of the matter remaining fixed on the floor of the furnace; but it contains a considerable quantity of sulphur from the pyrites and other sulphureous minerals.

To purify it from the sulphur it is treated in the way of sublimation, when it sublimes in its ordinary form.

Such is the history of this mineral, which best deserves the name of a poison of any substance we have expe-

rience of, as, in the ſmalleſt doſe, it has been found to produce hurtful effects.

DCCCXLV.

The ſtudy of the phyſician is more directed to the means of remedying the bad effects produced by it occaſionally, and to the detection of crimes that are committed by means of it, than to any other points. The means of preventing the bad effects conſiſt in the ſudden evacuation of the arſenic, by a vomit given immediately, and after that a purge, and we mitigate the miſchief it occaſions by giving a great quantity of diluent and bland ſubſtances, as milk, oil, and the like.

With reſpect to the means of detecting and diſcovering it, our attention is commonly directed to ſome ſubſtance ſuſpected of being arſenic, ſome remains of which are preſented to us, or to the examination of the dead body. In examining a ſuppoſed arſenical ſubſtance, it is eaſy to do it certainly; we need only put a little of it on a red-hot iron; if it evaporates with red fumes, or, when mixed with two parts of charcoal duſt, if it evaporates in the ſame manner and diffuſe a penetrating ſmell of garlic, it is then arſenical.

DCCCXLVI.

Molybdæna

Is a ſemi-metal, of a metallic luſtre or appearance ſimilar to plumbago. Its only ore is a native ſulphuret, of a light grey colour, ſmooth and unctuous on its ſurface, and of a ſoft laminated texture, ſoiling the fingers. It is difficult to reduce it to a metallic ſtate. Expoſed in the

fire to a strong heat, sulphureous flames are disengaged from it, and an oxyd prevails.

This metal is capable of undergoing oxydation in four different degrees. The first degree forms a black oxyd; the next, a blue; the third, a green; and the fourth, a concrete acid of a yellowish white colour. In these different states it possesses but a weak attraction for oxygen; and it is, therefore, deoxydated by hydrogen, and by digesting it with any of the metals.

The molybdic acid melts and is decomposed by heat; is soluble in about 750 times its weight of water, and in the sulphuric or muriatic acids. By its combination with the alkalies and earths various molybdets are formed which have not been yet examined. The same may be said of its combinations with a number of the metals.

DCCCXLVII.

Tungsten.

This has been obtained, in a metallic form, from the mineral named tungsten, or ponderous earth, and also from wolfram; so that both are ores of one metal.

DCCCXLVIII.

The metallic oxyd is obtained by digesting the mineral in fine powder, in three parts of nitric acid, when a yellow powder is deposited; or from wolfram, by boiling the mineral with muriatic acid. In both cases a yellow powder is procured, which is again reduced to the metallic state, formed into a paste with oil and charcoal, by exposing it to an intense heat. The metal is of a greyish colour, hard and brittle.

DCCCXLIX.

The yellow powder is taſteleſs, and inſoluble in water. It combines with the alkalies and ſeveral of the earths; but has leſs the character of an acid than of a metallic oxyd. Neither the oxyd nor the metal have been applied to any uſe; but the former has been prepared as a baſis for pigments, ſince it forms permanent colours with many vegetable ſubſtances.

DCCCL.

Titanium.

This is a newly diſcovered metal. It exiſts, in oxyd, in a greyiſh black ſand found in Cornwall, under the name of manachanite, and in the ore named titanit and red ſchorl. This oxyd is of a red colour; and by heating it with inflammable ſubſtances, it acquires a yellow or blue. It is very hard and infuſible; it is ſoluble with heat in the diluted mineral acids, affording gelatinous ſolutions that yield cryſtals by ſpontaneous evaporation, and are decompoſed by the alkalies. Pruſſiat of potaſh gives a green precipitate, and the gallic acid a browniſh red. It unites with none of the other metals but iron. It is alſo hardly reducible to a metallic ſtate.

DCCCLI.

Uranium.

This metal exiſts in the mineral named pech blende, combined with ſulphur and iron, in chalcolithe united with carbonic-acid, and in uranitic ochre mixed with oxyd of iron.

DCCCLII.

The oxyd of this metal is of a lemon yellow colour,

infusible by heat, but changed by ignition to a brownish grey. When mixed with carbonaceous matter, and urged by heat, metallic globules are formed which are of a steel grey, with little lustre. By heat it affords a yellow oxyd.

The nitric acid oxydates and dissolves it.

The other acids combine with it, and form neutral salts, which crystallize. Its oxyd combines with the alkalies, and by fusion it may be combined with the earths.

Both the metal and oxyd combine with sulphur.

DCCCLIII.

Tellurium

Exists in several ores of gold. Its colour is white or greyish, with a considerable share of lustre. Its texture is laminated and brittle. It is one of the most fusible metals, and is easily volatilized. It becomes oxydated by much heat, and burns with a blue flame.

DCCCLIV.

The oxyd of tellurium is white, turns yellow with heat, and it is not easily reduced by heating it with inflammables.

DCCCLV.

Tellurium is oxydated and dissolved by the nitric and nitro muriatic acids, and the saturated solution of the latter is decomposed by water. The sulphuric acid likewise dissolves this metal, and communicates to it a fine red colour.

The alkalies throw down a white oxyd from its solutions. It is also precipitated by iron, zinc, tin, and antimony. It unites with several of the metals.

DCCCLVI.

Chrome.

This metal is found in a species of lead ore, and it is named from its communicating brilliant colours to its combinations. The oxyd of this metal is the colouring matter of the emerald.

DCCCLVII.

The acid of chrome is of a ruby colour, in prismatic crystals, soluble in water, with a sharp metallic taste. It combines with the alkalies, and salts are formed of a golden yellow colour, and it unites with the different metals, forming compounds, distinguished by their splendour of colour. Fused with phosphoric acid, or borat of soda, globules are obtained of an emerald green colour.

DCCCLVIII.

Muriatic acid acts on it most powerfully. When heated with it, oxygenated muriatic acid is formed, and the solution assumes a deep green colour, from the oxydation of the metal.

The nitric acid oxydates it but sparingly.

DCCCLIX.

We have now examined all the principal metals but those commonly known as the most noble and perfect, which possess in a more eminent degree these qualities by which the metals in general are distinguished from the other classes. They are more perfect and unchangeable, resisting not only the action of the air, but some of the most powerful agents.

DCCCLX.

The qualities by which gold and silver are distinguished

from the other metals, are, 1st, Their amazing ductility and malleability in experiments made on silver, shew that a single grain can be drawn out into wire three yards in length, and this can be further beat out an inch broad. The extensibility of gold is still more astonishing, as we can learn from the art of gilding and of making gold lace, where the surface of silver wire is covered with a thin film of gold: thus four ounces of silver has its surface covered with one ounce, about half the bulk of one ounce of silver; it is then drawn out to such a degree that two yards of it weigh only one grain, which is made to pass through two steel cylinders; it squeezes into a flat part, and rolled on a silk thread, which is made to turn round with great velocity, till the whole is covered with it. During all this time the gold stretches out, so as to cover all the surface; and even when viewed with the microscope, it is all over covered with gold. Calculations shew that the thickness of such a film of gold is not above the four or five thousandth part of an inch. But the proportion of gold laid on silver, which is barely sufficient for covering its surface, is much less than this. It is necessary that the lace should bear some wear.

DCCCLXI.

Reameur, who has made experiments upon this subject, found that it was possible to cover the whole surface of the silver with a film of gold; that it was not equal in thickness to a millionth part of a line, so that it would require 12 millions of them to make up an inch. We seldom have any extensive ideas of such numbers, the imagination by no means comprehends them; but to conceive this a little more clearly,

let us only confider what thicknefs 12 millions of the leaves of common writing paper would make; the thicknefs would amount to more than half a mile, fo that the ductility and malleability of this metal is very amazing.

DCCCLXII.

Another quality is that of enduring the action of heat and air, without being oxydated. The ftrongeft heat, without air, does not produce the leaft effect. After exposing gold and filver in a glafs-houfe furnace for a month, they were unchanged; the filver had loft a fmall part of its weight, which might be imputed to its impurity. Some time ago we were told that gold and filver had been vitrified by the heat of the focus of the largeft French burning glafs; but feveral of the French academicians affure us that it was a miftake. It has been volatilized; but the vapours, when ftopped, condenfe into little globules of gold, in its metallic ftate; fo thefe cafes where it has appeared were deceptions, from the vitrifications of fome part of the fupport on which it was laid. This is a circumftance too in which they differ greatly from all the other metals, none of which can fupport the action of heat and air without being calcined.

DCCCLXIII.

Another circumftance in which they agree is, that they are not affected by nitre, which fo quickly oxydates the other metals. When heated violently with nitre they are in part volatilized, but they are not calcined or vitrified: fo it is employed to refine filver and gold, to deftroy any accidental impurity.

DCCCLXIV.

Another circumftance is, that they refift the fcorifying

power of lead. Different metals, heated in this manner, are calcined more or less quickly. Those having little attraction for oxygen, most strongly resist the action of lead. But there are none of them but what may be converted into scoriæ in this way, except gold and silver; these always remain the same with whatever quantity of lead we perform the operation. If the mixture is exposed to a scorifying heat, it is the lead which scorifies it, being converted into litharge, and separated, until nothing but the gold and silver remain perfectly pure, without any loss. In consequence of this property of gold and silver, very small quantities of it, (two drams,) can be separated from 100 lb. of lead: the whole lead can be scorified.

DCCCLXV.

Upon this is founded the manner of refining these metals, called cupellation. This is a putrefaction of them by means of lead in the cupel, which is made considerably thick, and of a spongy texture, and composed of materials which are not melted by the oxyd of lead. The gold and silver to be rectified are mixed with a quantity of lead several times exceeding the gold and silver, according to the quantity of impurity they contain; and, exposed to a scorifying heat, the lead brings on the scorification of the other metals, and the calces easily sink into the pores of the spongy vessels, which are compacted in a mould by the stroke of a hammer; but it has no clay to give it hardness or compactness, so they sink into the pores as water would do in a mass of chalk. And as the lead is converted into litharge, and the other metals into scoriæ, the whole is absorbed; while the silver and gold remain per-

fectly pure, the cupel is tinged of a yellow colour; it will drink in about twice its weight.

DCCCLXVI.

Silver.

The appearance and more obvious qualities of silver are sufficiently known. It is less liable to rust than most other metals; it is liable to tarnish upon the surface, not the effect of oxydation, but occasioned by an attraction of matter or effluvia, rather than separation of any thing, at least from the method of removing it, by making it red hot; and by the circumstances which bring it on, we are induced to imagine that it is occasioned by the adhesion of a quantity of sulphurated hydrogen. It acquires this tarnish when it is exposed to the steams of putrid substances, or to the subtile vapour arising from solutions of sulphur. It is observed by silversmiths that the heat of the sun is attracted by it.

DCCCLXVII.

It requires a strong heat to its fusion. When fused it looks like mercury, the surface is bright and clean; and when the silver turns again to a solid state, it is liable to start out into a number of branches, with a kind of explosion, called the vegetation of silver; that which is most highly refined is most liable to it; so it happens frequently in the cupel after the lead, &c. is separated: it is occasioned by a sudden start of congelation. It is liable to retain a quantity of latent heat after its sensible heat is diminished below the point at which it begins to congeal, just as water can be cooled below frost, and remain fluid; and upon some accident disturbing it the congelation happens with a start, with the same rapidity

that this congelation happens in water; and the external cruſt being ſuddenly congealed, and compreſſing the internal fluid parts, theſe get out, and are cooled by the air ruſhing out into a number of trunks, which ſtart out from them at the ſame moment.

DCCCLXVIII.

Several of the active ſalts afford it oxygen, and diſſolve it. The ſulphuric acid acts upon it as it does upon copper, and it muſt be applied ſtrong, with a boiling heat, when the ſilver is corroded, and forms a ſubſtance of little ſolubility, or ſulphate of ſilver.

DCCCLXIX.

The nitric acid is the moſt perfect ſolvent of ſilver, when it is properly diluted with diſtilled water. There is a gradual ſeparation of nitrous gas, and it forms a ſolution which turns out perfectly limpid and colourleſs; and when the ſilver is perfectly fine (in common ſilver there is a quantity of copper mixed), this ſolution has a remarkable quality for giving a black ſtain to many ſubſtances, particularly to animal and vegetable ſubſtances. The leaſt drop applied to the ſkin, nail, or hair, ſoon produces a black ſtain; and hence it is uſed for ſtaining hair, when it is largely diluted with water, giving a brown or black colour, according to the quantity. This ſtain is ſo durable, reſiſting the injuries of the air and other ſubſtances, that there is none more ſo; and it is now employed for marking linens before they are ſent to the bleach-field: it ſupports the action of bleaching without the leaſt diminution of its dark colour. It is obſerved to give a ſtain of this kind to ſome ſtones, as marble, agate, jaſper, &c. The marble contains a calcarious

earth, which may attract the acid; but these other stones are flinty; yet it finds subtile crevices, and lodging in them, assumes the black colour. It is produced by the attraction of oxygen, when the solution is exposed to the air, in consequence of its decomposition; for it never will appear if it is preserved in a perfectly dark place. We can even contrive to shew the effect of the oxygen more evidently, if a paper stained with it be put so that one part is exposed to the air, and the other covered up; that exposed acquires the black colour, while the other remains colourless. The operation of bleaching has rather a tendency to increase the blackness of the stain, and the only means of taking it out is by the application of nitrous acid itself, which with a gentle heat dissolves the metal again, and occasions the stains to disappear. This solution readily affords white crystals.

DCCCLXX.

The lunar caustic is made by melting these with a gentle heat, in order to unite them into one mass, which is cast into long rolls. If a stronger heat is used than is necessary to bring the mass into fusion, the acid may be separated; and it separates more readily by applying this compound to inflammable matters, as burning charcoal. Chemists have studied the art of separating the silver from the acid, so as to avoid any loss of the metal.

DCCCLXXI.

Besides the nitric acid, silver is combined with the muriatic. This acid does not act upon it in its metallic state; but it exerts a strong attraction to its oxyds, and particularly when added to nitrat of silver. Thus it

will desert any other acid to unite with the muriatic; and in whatever shape the acid is presented, with earth, chalk, &c. it always unites with the muriatic acid, and forms a compound perfectly insoluble in water, as appears in the form of a white powder: so silver in the nitrous acid proves the nicest test of muriatic acid in a mixture, and the muriatic acid is a nice test of the presence of silver in a mixture. This compound is called luna cornea, from the appearance it has to horn when melted. Melted in a dark place it forms a transparent substance, and when prepared with attention and care, it can be made almost as transparent as glass. It has at the same time a degree of flexibility; so upon this account too it has been thought to resemble horn. The acid and silver adhere strongly, and are not separable by heat, in the lowest degree of red heat. If the heat is raised higher, a part of the compound evaporates, and it penetrates through the bottom of the crucible, and the greatest part is lost.

DCCCLXXII.

The silver is separated from these acids by alkaline substances, by different processes, and also by the greater number of the metals. Copper is the most convenient, and is commonly employed. The surface of the copper is covered over with a down of silver, in its metallic state, like little scales adhering to the copper; the silver is thus readily precipitated. A little copper unites with the silver, but this is no disadvantage in business. The nitrous acid is recovered from the copper by heat more readily than from the silver. If our purpose is to recover the silver, fine mercury would be better; for this being volatile, it might be entirely separated; but mercury

precipitates it more slowly; and as purity is not aimed at, we are under no temptation to follow this method. But the experiment is amazing, in consequence of some phenomena attending it. When the solution of silver is diluted, the mercury for some time lies at the bottom, without any change, and is dissolved into an amalgam not different in appearance from the pure quick-silver; but at length it comes to crystallize; for the amalgams, when a certain quantity is united, are disposed to a sort of crystallization. In this case it is very remarkable and shining, shooting out branches, which rise to a considerable height in the glass, and having other branches issuing from them, like the division of common broom; this is called arbor dianæ, the experiment is among those which are the most precarious in chemistry; the success depends upon the strength of the acid, the dilution of the silver, and the quantity of mercury added. The mixture must not be disturbed; and it requires about 20 days, or a month, to complete the crystallization.

DCCCLXXIII.

The chemists would have combined it with the muriatic acid, had they known the way of recovering it without loss. There is no method of having it so pure as by making it into a luna cornea, and recovering it by cupellation; a minute quantity of copper, however, is left, which the lead has not power to scorify, being defended by the silver; but when precipitated from aqua fortis by means of muriatic acid, if there be copper in the solution, it remains dissolved; only the silver is precipitated: but to recover the silver by cupellation is attended with great loss, in consequence of the volatility and penetrating nature of these substances.

DCCCLXXIV.

When this metal is combined with ſulphur it forms a maſs reſembling lead, only of a duller colour, but with ſome degree of ſoftneſs, and it bears the impreſſion of the hammer. The ſilver is combined with the ſulphur by granulating it, by pouring it into cold water, and mixing the fluor of ſulphur, which melts and penetrates the ſilver, and forms a very fuſible compound. The ſulphur can be ſeparated by heat alone, or we may ſeparate it by the addition of other metals, many of which attract the ſulphur more ſtrongly, though ſilver is one of thoſe which have the ſtrong attraction for ſulphur; ſo it is uſed for refining gold.

DCCCLXXV.

It unites alſo readily with the other metals, particularly it has a ſtrong attraction for lead. If it is mixed with iron, the lead attracts the ſilver from the iron. The other metals diminiſh its ductility and malleability, except gold and copper. The copper, in ſmall quantity, gives more firmneſs and elaſticity to the ſilver, ſo is added to it in plate, in the proportion of one part to about 12⅓ of ſilver.

DCCCLXXVI.

The chemiſts have ſtudied more the art of ſeparating ſilver from other metals than that of combining them. It is worth while even to extract ſmall quantities of it from other metals, when mixed with the ores. This is done by different trials, according to the nature of the metals. If it is mixed with mercury it is ſeparated by heat, or by ſqueezing the amalgam with leather, and the remainder is decompounded by the application of heat, which converts the mercury into vapours. It is ſeparated from all the

reſt, except gold, either by ſcorification or cupellation with lead, where the ſilver is mixed with braſs, conſiſting of a perfect and ſemi-metal, when we muſt perform both theſe operations, which are diſtinguiſhed in this, that they are both done by adding lead and applying heat, till a quantity of the lead is converted into litharge; but ſcorification is performed in a veſſel which does not imbibe it, ſo that the ſcoriæ gather till they have acquired a proper degree of thinneſs to allow the particles of ſilver to be attracted at the bottom; then the operation is ſtopped, and the calces of the other metals acquire a certain quantity of the calx of lead, to bring them into a ſtate of fuſibility, according to their degree of fuſibility. Thus the calx of iron requires a great deal. When any of theſe are in the compoſition, it is proper firſt to ſcorify the maſs, that the ſcoriæ may be brought to a certain degree of tenuity, to allow them all to gather to the bottom, and a great deal of lead remains, in its metallic ſtate. To collect theſe this mixture is taken out and cupelled, by means of which the lead and copper, or other metal, is ſcorified and imbibed by the cupel, the fine ſilver remaining. When a ſmall quantity is to be refined, it may be melted with nitre; but this volatilizes a part of it, and it is expenſive for large quantities, as the nitre is totally loſt, whereas the lead can be recovered.

DCCCLXXVII.

When mixed with gold it can be ſeparated only by means of aqua fortis, or aqua regia; the one diſſolves the ſilver, and leaves the gold; and the other diſſolves the gold, and leaves the ſilver: but we have it pureſt by

adding aqua fortis, the aqua regia having a minute portion of gold.

DCCCLXXVIII.

With regard to its origin, it is found in all countries, but moſt plentifully in Peru, in South America. There is a very little of it in Britain; it occurs either in its metallic ſtate, or in the ſtate of an ore, or in the ores of other metals. It is found in little filaments or branches, like the leaves of plants, bedded in hard ſtones, or among the ores of ſilver, which contain it as their chief metal.

DCCCLXXIX.

It is not neceſſary to fuſe the ſilver in its metallic ſtate, the mineral is broken down into fine powder; the maſſes of ſilver do not eaſily divide, but retain their ſize; ſo they do not paſs through the ſieve, and any ſmall particles which do paſs through are afterwards ſeparated by waſhing, ſetting the earthy particles afloat, and allowing the metal to ſubſide; but mercury is found to be of uſe: it is always put into the veſſel, and a gentle heat ſometimes applied; it attracts the metallic particles, collects them at the bottom, and they are never ſet afloat again The mixture of ſilver with mercury is very remarkable, on account of its turning out remarkably heavy, though mercury is more heavy than the ſilver. This method is very much practiſed in Peru.

DCCCLXXX.

When ſilver is found in the ſtate of an ore, it requires other operations. The more remarkable ores are; 1. The minera vitrea, which is a compound of ſilver with copper; 2. The minera cornea, which reſembles the luna

cornea, and is supposed to be a compound of silver with muriatic acid; 3. The minera rubra, which is of a deep red colour, with some transparency, and often appears crystallized. These differ in this, that the minera cornea is flexible, while the minera rubra is quite brittle but very fusible, melting at the flame of a candle like wax or resin. It is a compound of silver with arsenic and sulphur, and hence its colour. Authors mention a minera alba, but this is more properly an ore of copper in which the copper is combined with arsenic, though the quantity of silver it contains is much more valuable than the copper; so it is considered as an ore of silver.

DCCCLXXXI.

It is separated from all these ores by scorification and cupellation with lead; it is separated from the earthy matter by elutriation, and the remainder is heated with lead in a hollow forge; the sulphur and arsenic unite with a portion of the lead, and promote the scorification; the metal is attracted by the melted lead at the bottom, while the litharge brings into a state of fusion the remains of the earthy and stony matter; so the scoriæ allow all the metallic particles of the silver to be united with the lead. The cupellation is managed in the large way, in a cupel of a large size, (of some feet in diameter,) heated in a furnace, of the form of an oven; at the same time two pair of bellows are made to play upon the middle of the cupel directly, and the wind of them is made to play with a sort of agitation, by means of a little plate of iron placed before the nasal of the bellows, which forms its elasticity, occasions a tremulous motion in the stream of air, by which the litharge is blown off to the opposite side, where a gutter is made to allow it to run out of the furnace, by

which means large quantities of lead are eaſily converted into litharge.

DCCCLXXXII.

Beſides it is often contained in ſmall quantity in the ores of other metals, and is ſeparated from them by different operations, according to the nature of theſe ores. The ores of this country, though but few, contain enough of it to be worth the working for ſilver. In England it is found in the quantity of one pound in 100 lb. and in a leſs proportion than in this country.

It is alſo contained in the ores of copper, from which it is ſeparated by means of lead.

DCCCLXXXIII.

Gold.

This is called ſol et rex metallorum. When quite pur it has no elaſticity; the fineſt kind bends backwards and forwards like a bit of lead, and it is the leaſt ſonorous of the metals. Its great ductility was taken notice of, and its great denſity and weight are always well known; but it is the leaſt fuſible of the metals, requiring a white heat. It never undergoes any change in the fire; but if foul, it always becomes bright. It withſtands the action of heat and air, though mixed with lead. Though the moſt intenſe heat was never known to alter pure gold, yet there are ſome metals which mixed with gold promote its calcination, as mercury and tin. In theſe mixtures the gold is very brittle, and it would ſeem that the melting of gold requires ſome care to prevent it from being brittle, either from a want of a ſufficient heat to make it perfectly fluid, or from its being ſuddenly cooled, this effect is produced, and it has been imputed to the

contacts of fuel; but it chiefly depends upon these two circumstances, and sometimes too it depends upon a very small quantity of metallic matter, especially tin.

DCCCLXXXIV.

None of the acids, applied pure, produce any change upon it, even in their most concentrated state. The only one that decomposes it, in its metallic state, is the oxygenated or nitro muriatic acids. The gold dissolves slowly; so it is proper to increase the surface of contact, and to apply a moderate degree of heat, when it will act with a sensible degree of effervescence, and the eruption of nitrous gas.

DCCCLXXXV.

The muriat of gold is easily decomposed by the fixed alkalies, lime, and magnesia. The precipitate is of a yellow colour. When ammonia is used a peculiar precipitate is formed, and is known in chemistry by the name of aurum fulminans, from its exploding with extraordinary violence, when heated. It is of a dull brown or yellow colour. By evaporation it affords yellow deliquescent crystals, or muriat of gold. It consists of a compound of ammonia and oxyd of gold. It sometimes requires to be heated to a considerable degree before it takes fire; but if we touch it before this, or apply the smallest degree of friction, the explosion is immediately brought on. During the explosion the gold is restored to its metallic state, there is a stain on the paper of minute particles of gold; and covering the gold with a glass receiver, the metal is dispersed over the surface of it, and in its cavity, in its metallic state: so this preparation is in danger of hurting people, and melancholy accidents have been occasioned

by it, from too much heat being applied to it, or from friction, by being bruifed in a mortar, and the water warm, &c.

DCCCLXXXVI.

From this view of the nature of the aurum fulminans, we can underftand how feveral fubftances come to deprive it of its exploding power. The volatile oils, or the others, added to the folution of muriat of gold, attract the oxygen of the oxyd, and the metal being diffufed through the liquor, in particles of great tenuity, communicates to it a rich yellow colour.

DCCCLXXXVII.

The muriat of gold is alfo decompofed by other metals, from their ftronger attraction for oxygen than gold. The moft remarkable of thefe is the precipitate obtained by the folution of tin. The tin is diffolved by means of the nitro muriatic acid, and a very minute quantity of gold in folution is put into a glafs of water, fo as to give it a barely fenfible yellow tinge. On adding fomewhat more of the folution of tin, there is a dark purple colour appearing in the mixture, which in a little time affumes a brighter hue, and will become a pleafant and rich purple, fimilar to that of red wines; and allowing the mixture to ftand at reft, the gold will be gradually depofited in the form of a purple precipitate. This is valued as being a very ufeful colour in enamel painting, retaining the colour well in the fire, which is a great property in colours ufed in enamelling. It is alfo celebrated as a preparation of gold, by means of which glafs may be tinged of a tranfparent red colour, which is an art that has been profeffed by few chemifts. At prefent it is fold, made into

tubes, which have no fenfible colour; but on applying the flame of a candle or lamp, the rich red colour appears. It is faid when the gold is diffolved by the ingredients of the glafs, it at firft difappears entirely, and becomes vifible by expofing the glafs, in its foft and melted ftate, to the flame of wood, or by throwing in nitre or muriat of ammonia. The other metallic folutions which precipitate it beft are the folutions of fulphate of iron and nitrated mercury, which are employed occafionally.

DCCCLXXXVIII.

Gold is not difpofed to unite with fulphur, but it can however be diffolved if the fulphur is combined with an alkaline falt, or fulphuret of potafh. This folution takes place with fome degree of violence, when the gold is thrown into it melted, and the gold, when recovered, appears purer than ordinary.

DCCCLXXXIX.

This metal is liable to a change of its colour; but it is alfo of many different colours, fometimes it is redder, fometimes of a greenifh caft, fometimes pale, perhaps from an admixture of fulphur; but the greenifh and red colours are by means which are kept fecret.

DCCCXC.

In ftudying the relation of gold to other metals, there are none with which it mixes more readily than quickfilver. The gold, being made into plates, readily forms an amalgam with it, which feels gritty, and in gilding it is diffufed with more mercury, and made to adhere; and the mercury evaporating, leaves the gold adhering to the furface. Mercury is ufed in this way, occafionally for

making a ring brittle, when ſticking upon a ſwelled and inflamed finger, and the ſtroke of a key, or the like, will make it fly in pieces. All the metallic ſubſtances mixed with gold render it brittle, and ſpoil its colour, except copper. But as gold, in its pureſt ſtate, is very ſoft, and rather unfit for veſſels, there is a ſmall quantity of theſe metals added, to give it more firmneſs, particularly copper, and the quantity of this addition is regulated by law, and the legal alloy is about $\frac{1}{12}$. Or they uſe a mixture of copper and ſilver, which rather heightens the colour, whereas ſilver alone produces a ſenſible paleneſs. The fineneſs is denominated in carats; a carat ſignifying the twenty-fourth part of the weight, whether it is a pound, ounce, or grain: ſo the fineneſs is denominated by the number of 24 parts of pure gold the maſs contains. If the whole is pure, it is gold of 24 carats fine; if there is $\frac{1}{12}$ of alloy, it is gold of 22 carats fine.

DCCCXCI.

The operations by which the gold is tried, or refined, from the admixture of other metals, are reckoned five.

1ſt, The touch-ſtone. It is but a rude extemporaneous trial; it is a ſtone of a black colour, which does not diſſolve in acids, and is ground into a rough ſurface. When a bit of gold is rubbed upon it a metallic line is left. They uſe it in order to obſerve the colour of that line, as gold of different degrees of fineneſs produces a difference of colour, and they can judge in ſome meaſure in this way. Further, they have a number of little plates of gold, all marked, to denote the fineneſs: ſo having formed ſeme judgment with this ſtroke, they draw another line with the plate which they ſuppoſe to be equal

in finenefs, and obferve if the colour is the fame. If it is not exactly the fame they draw another ftroke with another plate, and fo on till they get the colour to agree. But this trial by the colour is deceitful, as the colour varies as the gold is mixed with filver or copper, or with both of them.

DCCCXCII.

Another ufe therefore of the touch-ftone is to know whether it be really gold, or if it contains a large quantity of gold; fo drawing a ftroke or two, they apply aqua fortis, which will not touch the gold; but if it is any metal in imitation of it, the aqua fortis is fure to diffolve it: fo they judge by the ftroke difappearing or growing much fainter that there is fuch a mixture. However it is only an extemporaneous means.

DCCCXCIII.

The operation by which the gold is actually refined is either cementation, the operation with crude antimony, cupellation, or aqua fortis.

Cementation is an application to gold of either the nitrous or muriatic acid in the ftate of gas, or in dry and burning hot vapours, with common falt or brick duft. The gold is beat into thin plates, and put into a crucible with alternate layers of falt and brick-duft, to prevent the falt from coming into fufion, and fome calcined vitriol. The acid, feparated in dry and burning hot vapours, penetrates the gold, and feparates any impurity which can be wafhed off by water; but this method is now much out of ufe, for it is imperfect; as thefe vapours act only upon the furface, they do not penetrate deep; and, to refine the gold highly, we muft melt the little plates

all together, make it again into plates; and thus we do the fame operation two or three times.

DCCCXCIV.

The method by crude antimony is more frequently ufed. The impure gold is melted with it, and the fulphur of it immediately unites with any other metallic fubftance, filver not excepted, as there are none of them but what attract the fulphur more ftrongly than the antimony does; fo thefe, united with the fulphur, form a flag, or fcoriæ, which arifes uppermoft; and breaking the veffel, we find at the bottom the antimony and gold, which being collected together, the antimony is eafily volatilized or diffipated by heat, fo as to leave the gold quite pure. The metallic mafs is melted in a crucible, and kept melted with a red heat, the blaft of a pair of bellows is directed upon it, and as foon as the white fmoke difappears, we are fure it is well feparated.

DCCCXCV.

The moft ufeful operations are cupellation and aqua fortis, which naturally fucceed one another. In the firft of thefe a quantity of lead is added and fome filver, and the mafs is heated in the common way of cupellation; the lead is fcorified, and any coarfe metals are oxydated. In this operation fome filver muft be mixed with the gold, otherwife it will not part with its impurities; it will retain a fmall quantity of copper, and even of the lead, at the end of the operation.

DCCCXCVI.

The neceffity of adding filver, in order to make it part with thefe impurities, occafions the neceffity of the following operations of aqua fortis or aqua regia, according

to the proportion of metals. If aqua fortis is ufed, the quantity of filver muft exceed, otherwife the folvent will not readily extract the filver. Again, if we ufe aqua regia, the quantity of gold muft exceed, or the folvent will not readily diffolve the gold. The fuccefs of the operation too is a little different, according to the acid ufed; if it is aqua fortis it leaves a minute portion of filver adhering to the gold, at leaft this is faid, although later experiments do not altogether fupport this notion. If aqua regia is ufed, it leaves a minute quantity of gold adhering to the filver; fo we muft ufe the aqua regia to have the gold fine, as it will diffolve none of the filver, but precipitates any part diffolved by the nitrous acid. The diffolved gold has been recovered by precipitating it with mercury. Thefe are the operations, till of late, found fufficient for the refinement of gold. But not long ago a new metallic fubftance, platina, was difcovered, which cannot be feparated from gold by any of thefe means. It has not the colour of gold, fo is not to be tried on the touch-ftone; but it withftands the nitric and muriatic acids, and the operation of cementation; and being capable of being diffolved into fulphur, it withftands the operation of crude antimony. It endures, without lofs, the action of lead, and is not diffolved by aqua fortis; but like gold, in aqua regia. But we have difcovered methods of feparating thefe two metals from one another, which fhall be noticed under platina.

DCCCXCVII.

When gold is contained in fmall quantity only, the procefs is fomewhat different. It is feparated from all other metals, except filver and copper, in the fame man-

ner as ſilver, by ſcorification and cupellation with lead. But the gold is mixed with a large proportion of copper, perhaps one ounce in the hundred weight; in conſequence of the particular attraction between the gold and copper, the lead does not extract the gold. But a method has been found in Germany of extracting it with great profit, which is by ſeparating the copper; the copper is reduced into ſmall grains, by pouring it, in its metallic ſtate, into water. This maſs being afterwards melted with the oxyd of lead, readily affords the gold it contains. The lead now ſeparates it eaſily from this maſs.

DCCCXCVIII.

When it is mixed in ſmall quantity with ſilver, the operation is different. It is not worth while to diſſolve it in aqua fortis, as the quantity requiſite is very great, and the expence greater than the quantity of gold obtained. Sometimes the gold is upon the ſurface, as in gilt works; when it is equally diffuſed the ſilver is combined with ſulphur, and the gold ſeparates ſpontaneouſly; there is a quantity of ſilver at the bottom unchanged, the reſt being combined with ſulphur.

DCCCXCIX.

With regard to the origin of gold, the ſcarcity of this metal is the chief reaſon of the high value put upon it, though it is produced by nature in much greater quantity than is imagined It is found in the Brazils, in the Spaniſh Weſt Indies, in the Eaſt Indies, on the coaſt of Africa in large quantity, and in ſome parts of Europe. There are mines of it in Upper Hungary, which have yielded it for theſe ten centuries, and there are ſeveral rivers in France, the ſand of which contains gold; and in

this country gold was found in the foil in the neigbourhood of rich lead mines, and was extracted with profit when it was more valuable than it is now. From the accounts of travellers who have vifited the mines in America, we learn that gold is fometimes found in veins, like other metals, but is more generally found in the fand of rivers, mixed with the rubbifh of mountainous places and fand, with particles of quartz adhering to it, and is always found in its more metallic form, though containing a little filver, iron, and arfenic; but it is never changed fo totally by the combination of fulphur, iron, and arfenic as the other metals. It is found in grains, in different fizes, fome confiderably large, weighing fome pounds; but commonly in very fmall particles or films.

DCCCC.

As gold, in its metallic ftate, is a very ponderous fubftance, the manner of extracting it is generally by elutriation. When the particles are tough, and do not readily divide, they are prepared for pulverization by fire, heat making the gold more denfe and compact. You will find in Agricola, an author of great merit upon the fubject of metallurgy, methods of wafhing gold, and other ponderous minerals. In fome of the countries where the gold duft is rolled along the rivers, it was a practice to put fheep fkins in the courfe of the water, that the heavy particles might fink into the wool, then the gold was wafhed out, and to this is imputed the ftory of the golden fleece; and in a paper of Reaumeur's, among thofe of the Royal Academy of Sciences, we have a diftinct and pleafing account of the practice in France, for feparating the gold duft in their rivers. It is done by the peafants,

who obſerve the little change the river makes in its channel, and when a bank falls down the lighter parts are carried away, and the heavier parts ſink to the bottom, and in theſe places they find the greateſt quantity of gold. In the neighbourhood of ſuch places they lay a board ſloping towards the river; this has a ledge upon each ſide, and upon that they ſtretch a rough woollen cloth; then over the board they ſuſpend a baſket, like a ſieve, and they fill this with the ſand and rubbiſh; upon this they pour a quantity of water, which carries with it the ſmall particles of ſand, and the gold too, in ſmall particles, while the gravel and coarſe rubbiſh remain in the baſket. This operation they repeat till the baſket is quite filled with the heavier particles of the ſand. They then waſh it with water till they have collected a large quantity. This they waſh farther in ſhallow wooden veſſels, giving the ſand and water ſudden motions and jirks, to make a quantity of it fly over, and thus they free the gold from the greateſt part of the ſand.

DCCCCI.

In theſe parts of the country where the gold is found, ſtrangers often have their curioſity fulfilled by the inhabitants, who gather a quantity of looſe rubbiſh and gravel into a ſhallow wooden trough, and ſtirring all the parts with their hands, till they take out all the large ſtones, leaving only a pretty ſmall gravel; and adding water to this, and agitating the veſſel, they bring the coarſer parts to the top, and ſcum them off, while the heavier matters is left behind, and from one hundred weights, perhaps, they generally obtain two or three particles of gold, but ſo minute that they require a microſcope

to ſee them diſtinctly. It ſeems to be the caſe every where that it is diſperſed, in minute quantity, through a large proportion of other matter, ſo that the time and trouble beſtowed upon it is but ill repaid by the yield of gold; and from the accounts we have of the mines in the Spaniſh Weſt Indies, the yield of gold from large quantities of matter is but very moderate.

Sometimes the operation is finiſhed by mercury, which forms an amalgam with gold, which is more eaſily perceived and in leſs danger of being ſet afloat by the water; but it never acts completely in extracting the gold.

DCCCCII.

Platina

Is a metallic ſubſtance which withſtands all the trials formerly thought ſufficient to aſcertain the purity of gold. This metallic ſubſtance was firſt brought into England from Jamaica in 1749, and was firſt brought to that place from the Spaniſh Weſt Indies. The origin of the name is plainly from ſome reſemblance it bears to ſilver, being a diminution from *plata*, which ſignifies ſilver in the Spaniſh language. A ſpecimen of it was preſented to the Royal Society, and ſince that other ſpecimens have been imported into other parts of Europe, and it has been particularly attended to by ſeveral able chemiſts.

DCCCCIII.

The appearance of this metal is ſuch that a perſon not much accuſtomed to view iron filings would take it for them, but the colour is a little brighter. It is in ſmall grains, and ponderous: by far the greateſt part, viewed by the microſcope, conſiſts of theſe grains flatted and

ſmoothed at the edges. But there are other ſubſtances intermixed with theſe, as a ſmall quantity of blackiſh duſt, which is attracted by the magnet; ſo it is an ore of iron, or iron ſand. Beſides, there are generally ſmall particles of gold and a little mercury, ſome quartz, and ſometimes matters reſembling pit-coal; hence it has been concluded that it is a matter from which gold has been waſhed. It is probably mixed with the ſand from which gold has been extracted, and the ſmall particles of gold and mercury ſhew that mercury has been employed to extract it.

DCCCCIV.

It is of an extraordinary weight, nearly approaching to gold in denſity. The purer particles are 17 times heavier than water, and ſome of them 18 times, and gold is hardly 20 times the weight of water. The larger grains, tried on the anvil, ſhew but a ſmall degree of malleability, and it was conſidered as a ſemi-metal; but the want of toughneſs proceeds from its impurity, and it is as tough as gold or ſilver, but is remarkably difficult of fuſion. Thoſe who firſt examined it tried it by ſtrong fires, and increaſed them gradually till they melted their crucibles and furnaces, and ſtill it never united together. It ſeemed to be united, but ſtriking it with the hammer it immediately divided into as many grains as compoſed it at firſt.

DCCCCV.

In all theſe trials it withſtands the action of heat, as well as ſilver or gold; ſo it deſerves the name of perfect, or noble, as much as they do: and as it is unchanged by heat, ſo it ſtands the action of nitre, and other agents; by means of which the other metals are oxydated and

ſcorified, as lead, which does not contain it; nay, after the greateſt quantity of the lead is ſeparated, a portion of it is retained and defended by the platina, ſo that we cannot ſcorify it completely.

DCCCCVI.

In theſe reſpects it reſembles the perfect metals. Sulphur does not act upon it when combined with antimony; it is only diſſolved by the ſulphurets, and that only in ſmall proportion. When antimony is mixed with it, it may be evaporated without the leaſt loſs, nay, it retains a portion of the antimony, and defends it from the action of the heat and air. The nitro muriatic acid produces a ſolution of a ſtrong yellow or reddiſh colour, deeper than the ſolution of gold. This ſolution, however, differs from that of gold in ſeveral reſpects. The alkaline ſalts precipitate the platina completely, particularly the foſſil alkali, which does not precipitate gold in the ſmalleſt degree; and theſe ſubtile liquors which occaſion the precipitation of gold, ſpirit of wine, æther, and the oil of roſemary, which ſeparate the oxyd of gold from water, have no ſuch effect upon platina: it is therefore plain that the notion which ſome people took up, of its being a mixture of gold with ſome other metal, is falſe. With copper it forms a metal of a moderate toughneſs, which does not tarniſh in the air; with iron it forms a metal of extraordinary ſtrength and hardneſs, having the hardneſs of caſt iron, with a great degree of brightneſs, which caſt iron wants.

DCCCCVII.

When added to gold it produces a metal more uſeful to painters in enamel. They are obliged to uſe pure

gold, as the matter in which their colours are laid is more apt to throw off the cruft of enamel; but it is a foft metal, and eafily bent, and it melts rather too foon in the fire, not eafily enduring the heat neceffary for vitrifying the enamel on its furface. Platina may be mixed in certain proportion with gold, fo as to conftitute a metallic mafs, which cannot be melted but in a very violent fire.

DCCCCVIII.

The relation of gold with platina has been ftudied, on this account, that when it was imported the working of it was faid to be prohibited in the Spanifh Weft Indies, on account of the difficulty of diftinguifhing it from gold, the mixture withftanding the ufual trials, fo that it may be made to pafs for pure gold In order to learn if this apprehenfion was well founded, it has been mixed with many proportions of gold, but the colours were always found greatly altered.

DCCCCIX.

Scoffer diffolved the mixed metal in aqua regia, and added a folution of green vitriol, or fulphate of copper; as the gold is precipitated by folution of other metals, if they are not combined with the muriatic acid. In confequence of the ftrong partiality they have for the muriatic acid, they take it from gold, and the gold neceffarily precipitates with the other acids; fo upon adding the folution of green vitriol, or fulphate of copper, Scoffer was affured that the gold was completely feparated, and not the leaft particle of platina was feparated.

DCCCCX.

The foffil alkali which precipitates gold more effectually

than any other, as in the aurum fulminans, has not the leaſt effect upon the ſolution of platina. Mercury, when added to this ſolution of gold, diſſolves a portion of it, and the gold is precipitated in its metallic form. When the ſame mercury is added to the ſolution of platina it is not diſſolved, nor occaſions any precipitation of the platina, ſo that this may be an effectual method of ſeparating theſe metals occaſionally from one another. A ſolution of ſulphate of iron alſo precipitates gold diſſolved in the muriatic acid, but has no effect on platina.

DCCCCXI.

Cobalt.

This mineral has been long known, and when firſt extracting a metal from it they called it regulus or ſulphuret of cobalt. It contains a large quantity of arſenic, and the only uſe made of it is to extract arſenic from it. The oxyd remaining after the evaporation has the effect of tinging the clays of a rich blue colour, which is very durable in the fire. It is with this ſubſtance that the blue decorations of porcelain, and other earthern ware are performed, and the tranſparent blue colour of glaſs.

DCCCCXII.

The arſenic is ſeparated by roaſting it in an oven, when the ſteams are directed into a long vent at the ſide of a mountain, ſo that the condenſible parts are gradually condenſed, and they are afterwards ſcraped out and refined. Upon the floor of the oven is found a brown coloured oxyd, which melted with glaſs gives it a blue tinge; the glaſs is afterwards ground to a fine powder called ſmelt blue, and is uſed for bluing linen, or it is mixed with flinty matter, as quartz, and ſold by the name

of zaffre, and the manufacturers of porcelain and delft ware purchase it to decorate their ware.

This passed long for a mineral substance allied to the metal, till some of the Swedish chemists obtained with inflammable substances a metal of a whiteness approaching to that of silver, but quite brittle when it is struck with the hammer, and they called it regulus or sulphuret of cobalt.

DCCCCXIII.

The most remarkable qualities of it are, it dissolves in acids, so as to produce a solution of a reddish or rose colour. A solution of this kind is best obtained by adding to nitrous acid common salt; the nitrous acid unites to the alkali of the common salt, and the regulus of cobalt unites with the muriatic acid, forming such a solution as we obtain by adding the oxyd to pure muriatic acid; and though this is red, if it is heated, it acquires a green colour, especially when evaporated to the state of a salt, when it is made to afford a sort of crystals of a red colour, but which become green on being warm; so it forms an amazing sort of liquor, which becomes figures of a pale red, or which are hardly visible; but by being warmed, become green, or of a pale blue colour.

DCCCCXIV.

The sympathetic ink is produced by cobalt as well as bismuth; these two are often mixed together in their ores. But taking bismuth perfectly pure, it does not produce a liquor of this kind. If a drawing with this liquor is approached to the fire, the red colour gradually changes into a pale greenish blue, which appears to depend upon the evaporation of humidity from the saline compound upon the

paper. This change has been imputed to heat; but after the ftain has been changed in this manner, if it is expofed to humidity, or merely laid by, it returns to its former ftate, and the fooner the more humid the air is; fo breathing upon it makes it difappear much fooner than it would otherwife do.

DCCCCXV.

Nickel.

Nickel is of a reddifh colour, refembling that of copper. The metallurgifts have been long accuftomed to the knowledge of that ore, and were difpofed to expect copper from the appearance; but finding none, they gave it a fort of nickname, implying that it has none, they called it, *good for nihil*, and this was contracted to *nickel*. In this mineral the metal is always combined with a large proportion of fulphur and arfenic, and fometimes iron. When it is rendered pure, it is a white metallic fubftance, but with a reddifh caft, and it is perfectly brittle. The moft remarkable qualities of it are, that by long calcination it is converted into an oxyd of a green colour; at firft it is dark, but continuing the calcination it is green, and it refifts the action of other fubftances which are powerful in bringing different oxyds into a ftate of fufion; fo in thefe cupels ufed to effay minerals with lead containing fome fulphur and fome nickel intermixed; as foon as the lead began to fcorify, the nickel was thrown to the external edge of the melted lead, but it ftuck there; all the litharge had not the power of bringing it into a ftate of fufion; fo in this refpect it differs from all other metals.

DCCCCXVI.

Copper, oxydated by fire, produces an oxyd of a dark

colour, or with a reddiſh tinge, and when this is combined with acids it produces a green ſolution which can be made to afford a ſulphate of copper; and as nickel does very much the ſame thing, it is therefore probably one of the circumſtances which has made the chemiſts expect copper in the mineral containing it.

DCCCCXVII.

This metal is further diſtinguiſhed for having a ſtrong attraction for ſulphur, poſſeſſing a greater diſpoſition to unite with it than any other metal. It unites with it more readily than with iron, and retains it in the fire more ſtrongly, at the ſame time it is remarkable for not mixing with ſilver: in whatever proportion they are applied to one another they ſeparate again when brought into perfect fuſion; the ſilver and nickel are found lying in the ſame plane perhaps, and in cloſe contact with one another; but the leaſt ſtroke ſeparates them. It has been thought that it might be uſeful in ſeparating ſulphur from ſilver without communicating any taint to it. It is ſo difficult to obtain nickel pure that it is not worth while to have recourſe to this method: but there are ſeveral other methods for ſeparating ſulphur, as the adding half its weight of the cauſtic alkali, and melting the mixture; ſo there is no uſe to which this metal can be applied. It has not been tried much in mixture with other metals, at leaſt it has not been found to produce any uſeful compound. It has been tried if the green oxyd would produce a colour uſeful to the painters, but the colour is not ſo intenſe and bright as to anſwer their purpoſe.

DCCCCXVIII.

The metals are a claſs of bodies only a few of the in-

dividuals of which have been applied to the purposes of medicine. These few, however, afford remedies very active and powerful, and of extensive and varied operation. As all metals have been found to act on the body most powerfully in the form of oxyd; from their oxygen alone the principle of their action has been deduced, and their identity with acids in the mode of their operation conjectured; but when the subject is fully examined, although we find part of their effect is certainly to be attributed to the proportion of oxygen they possess, this by no means exhausts their properties, and something remains to be ascribed also to the base with which the oxygen is united. Hence though the acids suspend the progress of a disease, they by no means complete its permanent removal; and though they are much quicker in the progress of their influence in subduing the morbid action for the time, yet the latter, we find, is apt, at last, to spread its ravages in spite of their application; a proof that oxygen alone is not sufficiently permanent to counteract it.

Would the metals, if they were soluble in the animal fluids, be totally inert, should they be deprived of their oxygen? I apprehend not; and, if so, why should their qualities be ascribed to their oxygen alone? Much advantage, however, has been derived from a knowledge of this principle in their combinations; and by this knowledge we find the means of regulating their powers, in a manner much beyond what former practitioners were acquainted with. The faults of modern experimenters is the same with that of all theorists, a desire to simplify too much, and to admit the operation of one principle alone, where there is reason to think that several concur. In medicine

this is particularly the caſe, and we find peculiar combinations ſucceſsful in the removal of certain ſymptoms, without being all from the analyſis of theſe combinations, to account for the principle of their operation.

DCCCCXIX.

The firſt, and moſt important, of the metals in medicine, is mercury; and its excluſive infallibility, or nearly ſo, over the venereal diſeaſe, as well as its utility in a number of others, renders it the moſt valuable diſcovery that medical chemiſtry ever brought forward. Mercury is always applied in the form of an oxyd, and its oxydation takes place, as we have ſeen, either by triture, heat, or acids: we ſhall conſider it, therefore, rendered active by each of theſe means, beginning with its higheſt oxydation, as that with acids.

For long after the appearance of the venereal diſeaſe in Europe, there were only three methods of treating it. The firſt was by frictions; the ſecond, by guaiac decoctions; and the third, by fumigations with cinnabar. Of theſe, however, the moſt general was by frictions; till chemiſtry coming into repute, ſuch a rage took place, that none but ſaline preparations came to be employed; and by this form the mineral was ſuppoſed to have its virtues increaſed, or to be deprived of its ſuppoſed noxious qualities. From the effect, however, of theſe preparations, or rather the ignorance of phyſicians in their proper application, they have now come to be diſcarded, except a very few; the principal of which is the corroſive ſublimate, forming at preſent the baſis of many quack remedies in great repute. It was firſt propoſed by Dr. Herman of Leyden to be uſed in the cure of the gonor-

rhœa. This doſe was gr. ii. formed into a pill with liquorice; and he remarks, which was indeed neceſſary from the largeneſs of the doſe, that its uſe ſhould be confined to robuſt conſtitutions. Before his time, however, it had begun to be employed in London, for the ſame complaint, by an empiric, as we are informed by Dr. Turner, who gave it diſſolved in ſpirit of wine. And his method was, to diſſolve ℈i. of the preparation in ℥i. of ſpirit; and of this ſolution he gave his patient 10, 12, or 15 drops, in a quantity of barley-water, or any light decoction, ſo that his patient had but one fifth of a grain for a doſe; a practice much more judicious than Dr. Herman's. Dr Boerhaave next recommended this preparation; and, in his Chemiſtry, obſerved upon it, that gr. i. diſſolved in ℥i. of any diſtilled water, proved an excellent coſmetic; ℨi. of which ſolution, taken twice or thrice a-day, and ſoftened with ſyrup of violets, would do wonders in the removal of many incurable maladies; and by this practice $\frac{1}{8}$ gr. made the uſual doſe every day. But this remedy, ſo ſtrongly recommended by Boerhaave, was firſt brought into regular practice by his diſciple Van Swieten, and its ſucceſs eſtabliſhed in the Lock Hoſpital at Vienna, by his recommendation of it to Dr. Locher, phyſician to this charity, who has publiſhed ſome very excellent practical obſervations on its uſe. It was next carried to France; but its ſucceſs there was not equal to what happened at Vienna; and the French, indeed, have never been fond of employing this preparation. In Britain, the firſt introduction of it into practice was owing to the late Sir John Pringle. It was by him recommended to the notice of the army ſurgeons, and accounts of its ſucceſs publiſhed in the Medical Tranſactions; from which it ap-

pears a medicine of very quick operation in the removal of venereal ſymptoms, being therefore well adapted to military practice. The method of exhibiting it recommended by Van Swieten was ſimply this: Twelve grains of the preparation were by him put into a mattraſs with two pounds of ptyſan, ſubmitting it to a gentle heat, and frequently ſhaking it, till the preparation came to be diſſolved. Of this a table-ſpoonful was to be taken every morning faſting for 25 or 30 days; ſo that one grain came to be daily uſed; at the end of which period a cure was generally effected. But to this method of Van Swieten ſome objections may be made.

1. The diffuſion of it, in ſuch a quantity of watery fluid, does not allow its ſtay in the ſyſtem to be ſufficiently permanent. Hence we find the excretions of ſweat and urine moſt frequently produced by it.

2. From its ſtrong ſtimulant powers it poſſeſſes always a tendency to act in this way; which ſhould rather, by the form of its exhibition, be repreſſed. Some authors therefore have very properly recommended, though it ſeems merely with the view of leſſening its irritation on the primæ viæ, its uſe in a ſolid form. On this principle it was employed by Mr. Petit of Paris in the form of pills, giving to the quantity of half a grain a-day. In the ſame form Dr. Gairdner of Edinburgh has likewiſe uſed it, finding thoſe inconveniences avoided which attended its operation in a diffuſed ſtate. It was from the original manner then of uſing this preparation, that phyſicians remarked it ſeldom effected a complete cure, except in recent and ſlight caſes, from wanting that permanence of action, or durability of ſtimulus, on which the ſpecific ſuc-

cefs of mercury in the extinction of this difeafe depends. Hence, in modern practice, they feldom truft to it alone; it being common to employ it either in the commencement of the cure, from its quick abatement of venereal fymptoms, its diftinguifhing characteriftic; or when frictions have been employed; fo that towards the termination of the mercurial courfe, the abforbents of the furface tire of taking up the neceffary quantity of the remedy, it is given fufpended in fome of the alterative decoctions in fmall quantity in order to complete the cure. It is this preparation which forms the bafis of the Maredant's drops, of the rob. antifiphilitique and vegetable fyrup of Velno in France; and wherever it is ufed in a fluid form, a proportiom of fal ammoniac fhould be joined, which increafes the quantity of it receiving folution.

But, befides the internal ufe of this preparation, attempts have been made to introduce it alfo from an external furface. The firft of thefe, termed the Lavemens Mercurielles, was employed in France with a view to fuperfede the ufe of mercurial frictions. It confifted in immerfing the feet in a ftrong folution of corrofive, and retaining them there for a confiderable time, fo that a proportion of it might be abforbed without affecting the primæ viæ. But the fuccefs of this practice, though effectual in fome cafes, could not always be depended on.

A treatife has been alfo publifhed fome time ago by a profeffor at Naples, recommending its introduction by frictions. The fituation chofen for this purpofe is the foles of the feet, the fkin there being the thickeft; and he directs that ℥i. of the preparation be reduced to a very

fine powder, then mixed with ℥i. of axunge, which is to be triturated for the ſpace of 12 hours, ſo as to produce an intimate union, ʒii. of which are to be rubbed in each night; and he remarks, that in this way he has found it cure the moſt obſtinate caſes, which reſiſted every other remedy.

The next ſaline preparation in repute is calomel. It is much milder, in conſequence of the mode of its preparation, than the corroſive; and while the latter ſhows a natural tendency to the ſkin and kidneys, it, on the contrary, always affects the bowels. It is the preparation in moſt eſteem at Edinburgh next to the blue pill; but, from its particular tendency, it requires to be exhibited in ſmall doſes, except when it is meant to act ſolely as a mercurial purge. This tendency, however, is much leſſened by joining it with ſoap. It has been generally ſuppoſed beſt adapted to recent caſes, where there prevails ſome degree of active inflammation; for by its purgative property it operates here in ſome meaſure as an antiphlogiſtic: but there is ſuch a variety in the preparation of this remedy in different countries, that it cannot be depended on.

DCCCCXX.

The ſaline preparations with the nitric acid come next in order.

Dr. Ward's white drop, like every other quack medicine, we are little acquainted with; but from the reputation of its inventor, by whom it was very generally employed, we may entertain ſome idea of its ſucceſs.

Another medicine ſimilar to it is La Motte's, formerly in much repute at Paris. It conſiſts of a ſolution of red precipitate, or nitrated mercury, which gives it a bright

purple colour; and a few drops of this, taken in a quantity of any diluent liquor, were generally reckoned a sufficient dose.

Charas's solution is a less active medicine than either of the former; being the common nitrous preparation diluted with 24 times its weight of water. By this dilution a great part of the mercury precipitates; but its author observes, that so much still remains, and in that highly oxydated state, as to prove a useful medicine.

The vegetable syrup of Bellet was at first in great esteem in France, where more quack preparations have appeared than any where else; but since its composition has been guessed at, like most other medicines of the kind, its infallibility has in a great measure vanished. It consists, according to Dr. Swediauer, of nitrous mercury, precipitated by fixed vegetable alkali, and afterwards dissolved in vitriolic æther, when it is blended with some agreeable syrup; so that, from its composition, it must possess very active powers, though we cannot speak of the practice of it from experience.

In the unguentum citrinum, the activity of the preparation is weakened by its union with an oily matter blunting its natural causticity. It forms a very powerful remedy in cases of venereal eruptions, where the disease unexpectedly breaks out from some remains in the habit, discovering itself only at one particular spot; as an eruption of the furfuraceous kind about the roots of the hair, &c. But it is seldom applied to common venereal ulcerations; and even when used in these eruptive cases, it requires to be still farther weakened by the addition of more oily matter than what usually enters its composition.

Thus Dr. Cullen recommends it to be rubbed down with double its quantity of hog's lard.

DCCCCXXI.

The next preparations, according to our arrangement, are thofe with the fulphuric acid.

The turpeth mineral was a medicine formerly of much repute; but, from its violent effects on the primæ viæ, it is now feldom ufed, except where it is meant to act as a mercurial emetic. Where it is employed, it fhould be in very fmall dofes; and even then, its powers fhould be moderated by the addition of opium. It is pretended by fome authors to be more effectual than any other preparation of mercury in obftinate venereal eruptions of the fkin.

DCCCCXXII.

The faline preparations hitherto enumerated are thofe formed by folution in the mineral acids. But practitioners, wifhing to leffen the corrofive nature of thefe preparations, which they afcribed to the virulence of the acids forming them, inftead of the mineral, attempted to form them by folution in acids of a weaker kind; by which their cauftic effects might be weakened, and their fuccefs as mercurials ftill preferved. On this principle, a number of the preparations were compofed; the principal of which, deferving attention, are, Keyfer's pill, and the terra foliata of Dr. Preflavin.

DCCCCXXIII.

The Keyfer's pill is formed by the folution of mercury in the acetous acid; previous to which, to render its folution more complete, by freeing it of any extraneous matter, it undergoes repeated triturations, and is paffed

through a watery fluid: and after having finiſhed the ſeveral preparatory proceſſes, it is formed with manna, or any other ſaccharine ſubſtance, into pills. Their introduction into France met at firſt with conſiderable oppoſition. An opportunity being given for their adminiſtration in the Bicetre by the ſurgeon of that inſtitution, they were not attended with that ſucceſs which the accounts of their inventor led practitioners to expect. To judge, however, in an unprejudiced manner of Keyſer's pill, we may remark,

1. That it is a ſaline preparation; conſequently it muſt poſſeſs the ſame activity with any preparation of the mineral in that ſtate.

2. It is carefully freed from any extraneous matter before its ſaline ſtate is formed. And,

3. The acid with which it is combined is of a weaker nature than moſt others

On theſe accounts it muſt be a medicine of conſiderable efficacy; though the enumeration of its advantages over frictions, the common method employed in France, is by no means a juſt way of determining its real merit, as all the other internal preparations that do not act with too much violence poſſeſs the ſame advantages. It has ſeldom been uſed in this country, as the proceſs of preparing it previous to its ſolution is too tedious.

DCCCCXXIV.

The terra foliata, ſo termed by Dr. Preſlavin, the inventor, proceeds on the ſame principle with the former, being a combination of mercury with cream of tartar. The views of the author in forming this preparation were,

1. That it should possess the same advantages with the other preparations with the weaker acids, in being used with more safety than the strong saline compositions, and being at the same time sufficiently active to effect a cure. And,

2. That the body giving it the saline state should possess stronger powers of solubility than any other similar body of the same strength, and thus that more real mercury might enter into the composition of the preparation; the latter being on this account, according to common opinion, more successful in the cure.

For these reasons it deserves to be perhaps preferred to Keyser's pill; but the difficulty of forming such preparations has been one great reason that they have never come into general practice; and their merit, therefore, has commonly rested with the original inventors; to whom the strictest credit in their details of their success is not always due.

DCCCCXXV.

But before the solution of mercury with the weaker acids took place, which is of more modern discovery, practitioners, in order to diminish the powers of the saline preparations, endeavoured to separate the mercury from its combination, by which, part of its virulence acquired in solution might be lost; and thus the precipitates came to be formed. Their manner of doing this, however, did not always tend to lessen the activity of the preparation; hence, they found by experience, that the greater part of them were unfit for internal use.

DCCCCXXVI.

The first way they attempted it, was abstraction of the oxygen acquired from the acid, by calcination of the sa-

line body; but what it lost in power by the dissipation of its acid, it gained here in a different way by the process of calcination.

The next method, therefore, was, without calcination, to attempt the removal of the acid by the addition of such bodies as possessed a more powerful attraction for it than the mercury, or alkalies. But in very few cases can this abstraction of acid, even by alkalies, where it is combined with mercury, be entirely accomplished; and where any portion remains, the preparation still retains a great share of its activity.

To assist, then, the action of alkalis, which was found incomplete, recourse was next had to the assistance also of heat, consisting in the combination of the two former methods; but by this second process, the mildness acquired by abstraction of acid was counteracted by the degree of calcination they received, so that they were experienced still very powerful.

From the want of success, therefore, to render them milder in this way, instead of the alkalis, a trial was next made of effecting the same end, by their combination with compound substances; but the same exposure to heat being in the greater number of instances necessary to accomplish their union, the same effect was experienced to attend these compositions in their still retaining a very active state. Hence, the only method to render saline preparations milder, consists in the abstraction of the original acid as much as possible, without allowing any farther process to take place.

DCCCCXXVII.

From this view of the operation of mercury, it would

appear that the lefs oxydation the metal receives, the more certain are its anti-venereal powers; a circumftance which militates ftrongly againft the principle of the acids formerly detailed, and the other new remedies in this difeafe; nay, from fome facts we might be led to infer, that were the mercury reduced to a fimple earth, and could it be completely deprived of oxygen it would be ftill more permanently fuccefsful in producing a cure. To this conclufion we are irrefiftibly brought, if the facts adduced be juft:

1. That the faline remedies which poffefs the higheft oxydation, when trufted to alone, in the greater number of cafes fail in effecting a permanent removal of the difeafe.

2. That the fimply calcined or oxydated forms are more fuccefsful than the former; but,

3. That the triturated ones, in which the oxydation is leaft by the univerfal confent of practitioners, ever fince their introduction, have been more confided in than any other, and that the blue pill and ointment are, as a proof of it, more in ufe than any other preparations of the prefent day.

The faline remedies, therefore, like the acids, may be employed to fufpend quickly the violence of the fymptoms at firft, or they may be ufed fimply to keep up the mercurial difpofition in the habit for fome time after the cure, as a matter of precaution.

DCCCCLXVIII.

The next metal that has equally employed the attention of chemifts for the purpofes of medicine as mercury, is antimony; and where mercury has been appropriated in a particular manner to the removal of certain forms of chronic difeafe, antimony has gained its chief reputation by attacking

thoſe of an acute nature, and particularly of the febrile kind. From oxydation it derives the moſt active powers to ſuch a degree indeed, as to require to be moderated by ſubtracting part of its oxygen, and exhibiting it in divided doſes in the moſt cautious manner. No medicine ſeems to poſſeſs ſuch extenſive and uniform powers over the diſcharge by the ſkin, and its exhibition is alſo ſure to remove that conſtriction of ſurface ſo generally preſent in febrile diſeaſes, with the reſolution of which we find a criſis ſo often attended.

The uſe of antimonials in dyſentery is a practice founded on the ſame principle as their operation in fevers, and as this diſeaſe is always diſtinguiſhed by the ſtate of ſurface conſpicuous in fevers, and other marks of a morbid determination to the bowels, the reſtoring it to its proper channel is neceſſary to the cure. Hence antimonials in the acute dyſentery and mercury in the more chronic is a proper diſtinction in practice. But the introduction of mercury in acute diſeaſes is now a practice which is ſuperſeding every other, and from its permanent ſtimulus it has been found preferable to the more active but leſs certain operation of antimony. Hence its application in warm climates in typhus, in cynanche-malga, and in a number of affections to which it was formerly reckoned hoſtile in its nature, in which diſeaſes, till the mercury has fully entered the ſyſtem, no remiſſion of the ſymptoms occurs; but from this period, a proof of the mode of its action, a decline of the malady takes place.

DCCCCXXIX.

The chief preparations of antimony in uſe are the James's powder, or tartariſed antimony and the emetic

wine. The former of these has been generally used in all cases of incipient disease, attended with febrile symptoms, in full doses, and afterwards continued in nauseating quantity, so as to produce a remission, chiefly by relaxation of the surface. The latter is more used in the complaints of children than in the cases of adults. No mineral affords a remedy of so uncertain operation as the antimony, from its strong attraction for acids; its oxydation is powerfully increased in the stomach wherever a disengaged acid occurs, either as the effect of disease or from the particular state of the contents of the stomach at the time. To render it a safe medicine, therefore, the great object has been to reduce it to an imperfect oxydation, and of all the forms for doing this that of the James's powder has gained the preference. It is from this circumstance, in order to render its operation milder, that some attempts have been made to introduce it, like mercury, from the external surface. This is done by frictions, either with a solution of tartarised antimony, or with it formed into an ointment, in the proportion of a scruple at a time. From the manner of its introduction, and meeting no disengaged acid in its course, as in the primæ viæ, its operation never, we are told, arises to any alarming height, and the secretions are gradually increased by it. Perhaps in this form it may be best suited to the cure of chronic diseases.

The sulphur antimonia precipitatum, and some of the other preparations, are chiefly employed in combination with mercury in chronic diseases of the skin.

DCCCCXXX.

The next metal introduced into medicine is zinc. An attempt has been made to employ its oxyd as a remedy

in convulfive difeafes. From its aftringent tonic nature; where thefe difeafes are the effect of fimple debility and relaxation, without any permanent local caufe, it may be fuccefsful, and accordingly well attefted inftances of cure are on record; but its powers extend no farther. Of late it has been tried to combine this mineral with mercury, under the title of the calx zinci hydrargyrata, by adding to three parts of the triturated mercury by turpentine two parts of oxyd of zinc, by precipitating white vitriol by kali, and this combination is confidered as wonderfully powerful in the cure of lues, and as acting by a powerful and tonic operation, without much increafing any of the fecretions. The white vitriol is chiefly ufed as an external application, efpecially in eye-wafhes, and as an injection in gonorrhœa. Where internally employed it is as a vomit, where the operation of an emetic is required quickly, as in cafes of poifon. The oxyd, however, in the form of ointment, forms an ufeful application to gleety fores.

DCCCCXXXI.

Lead is a metal of more general application than the laft, but its ufe is almoft exclufively confined to external forms. In cafes of hæmorrhage, and in fome cafes of phthifis, the ceruffa acetata has been cautioufly employed in very circumfcribed dofes, and an alleviation of fymptoms has fometimes attended its exhibition. But while it is thus dangerous and uncertain, as an internal remedy, it poffeffes much fuccefs as an external application. Whole volumes have been written in its praife, and the enthufiafm of Goulard carried it almoft the length of an univerfal remedy. That it proves highly cooling and

ſedative, in caſes of local inflammation, there is no doubt, and eſpecially where there is much irritation and pain. From its aſtringency it is ſucceſsful alſo in ſuch ulcerations as are the effect of ſimple relaxation, and in gleety diſcharges its powers are uſeful wherever it can be ſafely employed. This, however, is the extent of its virtues. The more highly oxydated the more ſerviceable it is found, and hence its ſolution is commonly made in the acetous acid previous to uſe, ſo as to increaſe its oxydation to the higheſt degree. On this account the ceruſſa acetata is its preparation moſt in repute, though the ceruſſa itſelf is occaſionally employed.

From the deletereous nature of this metal moſt of thoſe employed with it are ſubject to be morbidly affected, in a peculiar manner, as it either occaſions ſpaſmodic cholic or palſy. Theſe complaints begin here with obſtinate conſtipation or griping pains in the bowels, paralytic affection of the extremities, a ſallow complexion, and great emaciation. The progreſs of ſuch ſymptoms is gradual, and therefore the workmen generally continue ſo long that they are incurable before they have recourſe to aſſiſtance. The ſame ſymptoms occur in a leſſer degree from the uſe of ceruſſated wines, the detection of which we have conſidered elſewhere. Oils and ſulphur, properly employed, prove the only cure.

DCCCCXXXII.

Tin, the next metal, is of ſmall importance in medicine. It has been employed in powder, as a vermifuge, with the view of acting by its gritty nature, in rubbing againſt the inteſtines, and thus removing the ſlime in which the worms are involved; but it is preferable for this diſeaſe when employed in the form of an amalgam.

DCCCCXXXIII.

Iron is of all others the metal the moſt congenial to the human frame. It exiſts in it as a conſtituent principle, and the effects of morbidly augmenting it, which has been tried by the Italian phyſicians, is to increaſe not only the quantity of the colouring part of the blood, but alſo the general quantity of fibrine in the ſyſtem. It is therefore a powerful and univerſal tonic, increaſing by its oxydation both the colour of parts, and the general heat and animation of the body. The exact quantity of iron preſent in the ſyſtem is difficult to determine, as authors are not agreed upon it. It is taken in greateſt quantity from animal food, though it is liable to be changed ſomewhat by the effects of cookery previous to its introduction. Iron acts moſt powerfully when employed in the moſt imperfect ſtate of oxydation; for of all the metals that enter the body, as medicine, it is the moſt liable to attract oxygen there. The ſituations of diſeaſe to which it is chiefly applicable are thoſe in which an imperfect animalization is diſplayed, and where weakneſs proceeds from a defect in the conſtituent principles of the ſyſtem, either in conſequence of original conformation or accidental cauſes. This ſtate is particularly characterized by a pallid countenance, by want of natural heat, and much diſengaged acid affecting the primæ viæ. In ſuch caſes the uſe of iron is experienced moſt ſucceſsful, particularly if joined with that proper quantity of nouriſhment which will afford animal gluten ſufficient for the action of the medicine, or in order to its perfecting the proceſs of animalization. In all caſes of inflammatory diſpoſition this medicine has been reckoned hurtful, and even in that

chronic inflammation which is combined with ſome obſtruction of the viſcera or ſmall veſſels it is equally ſo. Where ventured on here it ſhould be in the form of a mineral water, as the ſaline combination will counteract any exceſs of its tonic power.

DCCCCXXXIV.

Manganeſe has been conſidered as a ſpecies of iron, but by its medical effects it does not appear ſo. While iron is the moſt ſalutary to the human frame, this metal cannot be exhibited without much danger, by inducing the moſt active inflammatory ſtate. It exiſts in ſmall quantity in all animal bodies; but from ſome experience of its effects we venture decidedly on this opinion. Externally it may be ſafely employed, and it has accordingly been uſed with ſucceſs in cutaneous diſeaſes, particularly the itch, in the form of ointment.

DCCCCXXXV.

Arſenic, of all the metals, is the moſt deleterious to animal life, and every day teems with inſtances of death from its imprudent application. As a medicine it has been long introduced, from its ſuppoſed tonic powers, and applied to the cure of obſtinate intermittents, cancer, and ſome other ſpecies of ulcerations. In the firſt its uſe is perhaps leſs exceptionable than in the ſecond, for here its application is generally for a very ſhort period; but wherever the diſeaſe requires its long continuance, its pernicious conſequences in undermining the conſtitution and ſapping the general health, will greatly counteract any temporary advantages to be derived from it. On the ſubject of cancer little can be ſaid in its favour. That in certain ulcerations, reſembling cancer, it has occaſionally

succeeded, there is no doubt; but in real cancer, from much experience, we have ever found it do harm. In all cases it is exhibited in the form of an oxyd, and from its strong attraction for oxygen, it must be uncertain in its effects in different constitutions, when introduced into the system. No metal has its activity so much counteracted by sulphur as this. According to the quantity combined it can be reduced almost to an inert state, a proof of its strong connection with the saline nature. In ulcerations it has been applied chiefly externally as a caustic; and under the name of Plunket's powder, and some others, it has acquired considerable reputation, as it possesses the particular quality of acting without much pain, and induces on the part a speedy and effectual spacetus. One great secret to its success is the time it is allowed to lie, that a complete separation may ensue.

DCCCCXXXVI.

An attempt has also been made to combine this metal with others. In a communication to my much respected friend Dr. Garthshore, by Dr. Clarke of Dominica, the success of two combinations, the one with antimony, the other with mercury, are strongly instanced. The arseniate of antimony is prepared with the acid of arsenic, and the crocus or vitrum of antimony, in the same manner, and nearly in the same proportions, as the antim. tartariz. or tart. emetic, only with a larger proportion of the acid. arsenici filtered, chrystallized and pulverized; and the dose he used is $\frac{1}{12}$ of a grain, in the form of a pill, twice a day; and after using it some time, he ventured to give $\frac{1}{8}$ of a grain, in the same manner. This is the most useful of his two new remedies, the sensible

effect of which is by ſweat, and its effects are very evident and extraordinary on the leproſy of that country, viz. elephantiaſis or lepra grecorum; and it may do good in the ſcaly leproſy.

DCCCCXXXVII.

The arſeniate of mercury, or hydrargyrus arſenicatus, although not ſo uſeful as the former, is more difficult of preparation. To a ſaturated ſolution of the nitrate of mercury add a ſaturated ſolution of arſenic. tartariz. or oxyd of arſenic ſaturated with fixed alkaline ſalt, by degrees, till the effervescence ceaſes, by which means a double elective attraction will take place, by the acid of nitre laying hold of the fixed alkali, and leaving the mercury to unite to the arſenic; or it may be prepared in the following manner, viz. Precipitate the mercury from the hydragyr. nitrat. by the addition of fixed alkali, and to the precipitate ſo obtained add the acid of arſenic, and boil it until a ſolution takes place; which, on cooling, will chryſtallize, in the ſame manner as it does in the hydrargyr. acetatus, of which Keyſer's pills were ſuppoſed to be compoſed. Of this reduced into fine powder he began by giving $\frac{1}{16}$ only of a grain, and afterwards $\frac{1}{12}$, for its operation is more powerful, ſometimes griping and purging, if given in larger doſes; its chief effect is however by ſweat, when given in very ſmall doſes. With it he has cured ſeveral negroes of the yaws, but more eſpecially of the return yaws, ſo common in the Weſt Indies, from bad treatment at firſt, and ſo difficult of cure, as is known to every medical practitioner in theſe iſlands. He knows not for what diſeaſe this preparation might be uſed

in a cold climate, perhaps in ſlight cancerous caſes, or as an antiſyphilitic. The other may be uſeful in cutaneous diſeaſes, eſpecially ſuch ſcaly ſcorbutic complaints as are commonly denominated leprous.

DCCCCXXXVIII.

Copper is a metal which is more dangerous as a poiſon than uſeful as a medicine. It has been introduced, however, as a tonic in nervous diſeaſes, under the form of the caprum ammoniacum, and in this form it has often been experienced highly ſucceſsful where ſuch affections do not depend on any local cauſe. Externally uſed it forms a powerful application in certain caſes of ulceration. From its uſe as a kitchen utenſil, accidents often ariſe by the oxydation of the metal giving a taint to the alimentary ſubſtance they contain. This generally happens in conſequence of the tin covering or layer being worn off ſuch veſſel, and the alimentary ſubſtances being allowed to ſtand in them; for the oxydation of this metal takes place more readily in a low than increaſed temperature, and cold liquors therefore have a more powerful effect. The conſequence of this impregnation is to produce violent ſickneſs and vomiting, and when proceeding farther, general pains through the body and affection of the eyes. In ſuch caſes dilution at firſt, and oils and ſulphur afterwards, will counteract the effects of the poiſon. The ſame conſequences have been known at times to follow the uſe of vinegar, from an impregnation of this metal.

DCCCCXXXIX.

Of the newly diſcovered metals none of them have been at all applied to the purpoſes of medicine, and of

the nobler metals, ſilver and gold, the argentum nitratum of the former is the only preparation in uſe. It forms the moſt uſeful cauſtic in ſurgical practice, and is externally applied for this purpoſe in moſt caſes. Of late it has been introduced as a medicine internally, in caſes of epilepſy, and other nervous affections, with the ſame view as the oxyd of zinc, and it is ſaid with more decided ſucceſs.

*DCCCCXL.

From this view it appears that the metals afford a number of powerful remedies, but in the exhibition of them their form ſhould be regulated by the nature of the diſeaſe. Where metals are employed as medicines to ſubdue particular ſymptoms, and their action is quickly required, their oxydation and ſolution in acids is certainly their moſt powerful form. By this form they combine the powers of the remedies of the former claſs, or the ſalts, along with the peculiar property they acquire from the metallic baſe. By the new experimentaliſts this laſt circumſtance has been loſt ſight of, and their action alone attributed to the ſaline form. In all chronic diſeaſes, however, or where a continued and permanent action is neceſſary of a metal as a medicine; the more imperfect its oxydation the more ſucceſsful will its operation be found, and hence, as formerly inſtanced, the ſuperiority of the tritured preparations of mercury over every other, from that metal being in its leaſt oxydated ſtate. The precipitates we ſhould conſider as the moſt certain forms for medicines, could they be entirely freed from their oxygen.

DCCCCXLI.

Animal and Vegetable Subſtances.

To finiſh our account of the objects of chemiſtry, it remains to examine the nature of the vegetable and animal ſubſtances.

All animal and vegetable ſubſtances are of a compound nature, and by this compoſition they are diſtinguiſhed from the different bodies hitherto examined. The principles in all of them are the ſame; their union and modification are only found different; they cannot be imitated by art, as they are peculiarly combined in the veſſels of the organic being, ~~and are~~ under the influence of the principle of life.

Their combinations, however, are ſo nicely balanced as to render them liable, on the ſlighteſt cauſes, to decompoſition and change. This is effected either by the chemical powers, as heat, mixture, &c. or by the ſpontaneous action of their own principles on each other. This decompoſition taking place, occaſions new combinations of their principles to be formed; and theſe new combinations, from the ſimilarity of their principles, are in all theſe ſubſtances the ſame.

DCCCCXLII.

The ultimate principles of vegetable bodies, are carbon, oxygen, and hydrogen. The ultimate principles of animals are the ſame, with the addition of azote and phoſphorus. A proportion of ſaline earthy and metallic matter is alſo found, but it is both inconſiderable and not conſtant. Lime and iron are the moſt conſtantly preſent of what we may term the extraneous elements.

DCCCCXLIII.

Animal ſubſtances differ chiefly from the vegetable in their ſtronger tendency to the proceſs of putrifaction; and this tendency is the conſequence of their greater proportion of azote, phoſphorus, and ſulphur; the combinations of which yield largely of ammonia. Thus vegetable and animal ſubſtances may be conſidered as produced by a looſe and ſlight collection of the principles

which conſtitute other bodies. Their production and growth are more rapid, and they have a conſtant tendency to as quick a diſſolution of their conſtituent parts.

DCCCCXLIV.

Vegetable Subſtances.

The vegetables come to be firſt conſidered, as having an intermediate nature between the animal and the dead part of the creation; for the vegetables are produced from the dead inorganic ſubſtances, while animals again proceed from them, either immediately or through the intervention of other animals.

DCCCCXLV.

In entering upon this ſubject, we would indulge a little upon the immenſe variety of vegetables with which the ſcene of nature is beautified: ſome heighten it by their height, ſtatelineſs, and form; others by their order, elegance, and ſymmetry, diverſified by their different ſpecies, and ſtill more by their beautiful form, the colour in their flowers, and the fragrance of their ſmell; but beſides their beauty, many of them hold a much ſuperior rank, furniſhing food as well as the neceſſary ſhelter for the different animals; and many are valuable, as being poſſeſſed of medical qualities, or for being otherwiſe uſeful in arts. For one or other of theſe purpoſes different kinds are adapted to different climates: the bleakeſt hills nouriſh plants which will not grow to perfection in warmer ſituations; and by attending to this, botaniſts have reared in their gardens many plants which could not be brought to perfection before; we need not mention the immenſe proviſion made under water for the food and ſhelter of animals confined to that climate.

DCCCCXLVI.

Without entering into the ſtructure and economy of vegetables, the detail of which belongs to another place, the variety of ſubſtances which are diſtinguiſhable, in them we find referable to nineteen different kinds.

DCCCCXLVII.

1. With regard to the ſolid fibres, or wood, it is little an object of chemiſtry; it may be compared to the bones in the ſkeleton of animals. It remains after all the other ſubſtances are extracted by the different proceſſes to which the vegetable is ſubjected, free of taſte or ſmell, and inſoluble in water, but ſtill retaining a quantity of carbon; its principles are more ſtrongly combined than thoſe of the other ſubſtances which the vegetable contains, and cannot be ſeparated but by fire or putrifaction, to which it is much leſs ſubject than moſt of the other parts. Sometimes we meet with this part ſeparated completely, after a long and frequent decoction of the vegetables; at length, we have a matter ſtill retaining the form, but quite deſtitute of any ſort of juice, free of taſte, odour, or any other ſenſible quality.

DCCCCXLVIII.

2. The ſecond principle is the mucilage, or gum. This matter, when it appears in the greateſt perfection, is inſipid, inodorous, ſoluble in water into a viſcous fluid, not ſoluble in alcohol or oil, not volatile in the heat of boiling water, or fuſible, nor more inflammable than the vegetable ſubſtances in general are.

DCCCCXLIX.

This ſubſtance abounds ſo much in ſome vegetables, that the veſſels burſt and ſhed this juice. In this manner the gum arabic is obtained, and the gum tragacanth, and all the other pure gums, which are employed in pharmacy and in arts. We can ſee it break out from the bark of our common plumb and cherry trees; we ſee a viſcid tranſparent juice liquid like water, but which concretes into a ſolid tranſparent ſubſtance upon being expoſed to the air.

DCCCCLV.

This ſubſtance, though not acted upon by oils, ſhews a remarkable diſpoſition to unite with them, when in the ſtate of a mucilage, when combined with water in a viſcid fluid; and it not only unites with them, but renders them miſcible with water; but unleſs a conſiderable proportion of them be uſed we have not a perfect ſolution of the oily

matter, and it is liable to ſeparate and riſe again to the top, but the gum is notwithſtanding diſſolved, and combined to a certain degree with the water; and if the quantity of gum is ſufficient, the union is ſo complete, that it will hardly ſeparate at any rate; ſo that this ſort of combination may be conſidered as a particular ſpecies of ſolution, and has been properly called emulſion, from the reſemblance the mixture has to milk; the minute parts of the oil, which are not perfectly diſſolved, reflecting the light, ſo as to give the appearance of milk.

This ſort of combination is very frequent in plants, all theſe giving milky juices containing a ſubſtance of this nature; ſuch juice being a combination of oil and reſinous matters with water, by the intervention of gum. Theſe juices, on being allowed to evaporate, concrete into a dark coloured ſubſtance, which is properly called a gum reſin, containing a gummy matter, and reſinous or oily matter united together at the ſame time. There are many of ſuch compounds employed in pharmacy, as opium, aſſafœtida, myrrh, ammoniacum, ſagapenum, galbanum, &c. and the greateſt number of the reſinous ſubſtances have it more or leſs united with them, as more or leſs of them can always be diſſolved in water. This power of gum in promoting the ſolution of oily and reſinous matter in water is particularly worthy of attention, becauſe it is uſeful in pharmacy.

There are many plants the medical parts of which are reſinous or oily; perhaps this is the caſe with the whole, or by far the greateſt part of the vegetables remarkable for their medical power; it reſides in ſome ſubſtance of an oily and reſinous nature; now it happens, that theſe ſubſtances, as extracted from their reſpective plants, prove difficultly ſoluble in the ſtomach, ſo it is neceſſary to add ſome other ſubſtance which will promote their combination with water, and we cannot have recourſe to any thing better than gum; for a gummy matter is free from this inconvenience: a ſlight acidity in the ſtomach has no other effect upon it than pure water; ſo it is the moſt proper

ſubſtance to be added to reſinous bodies, to promote their ſolubility in the animal humours.

DCCCCLI.

Gum is oxydated by different acids. The nitric acid converts its into oxalic, and the oxygenated muriatic acid into nitric; but it cannot be converted into ſugar, or made to paſs into the vinous fermentation: its watery ſolution becomes clear, and forms the pyromucous acid.

By the analyſis of gum its conſtituent principles appear to be oxygen, hydrogen, carbon, azote, and lime; and from the two latter its chief production ariſes.

3. The third kind of matter we mentioned is the aromatic oils and reſins.

The nature of theſe we treated of when we were conſidering the variety of inflammable ſubſtances; and obſerved, that they were found chiefly in vegetables: any examples of them found in animals are very rare.

DCCCCLII.

4. The zecula, or ſtarch, is a particular principle, which is moſt abundant in the nutritive grains and roots. It is extracted by beating or kneading them in water, and when properly prepared, is in the form of a light white powder, inſipid, inodorous, and ſoft to the touch. It forms a gelatinous ſolution in hot water, but is inſoluble in cold, and the ſame takes place when in the ſtate of jelly; this circumſtance diſtinguiſhes it from gum. It is alſo inſoluble in alcohol.

Fecula is diſſolved and oxydated by ſeveral acids; by nitric it is converted into malic and oxalic acids. Fecula is alſo convertible by a peculiar proceſs into a ſaccharine matter.

DCCCCLIII.

This proceſs is rather an operation of nature: it is an effect of the vegetative power; but art is employed in modifying the proceſs, as in malting There are different kinds of grain, which may be ſubjected to this; but that

commonly employed is barley. The operation is to bring on a certain degree of vegetation; it is firſt ſteeped in water, and after a proper quantity of humidity has been employed, it is put up in heaps, when a ſlight degree of heat is produced, by a ſlight degree of fermentation, and with this heat and humidity it begins to vegetate or germinate, as appears from the ſhooting of the two principal parts of the vegetable from the centre of the ſeed, the plume or rudiment of the upper part, and the radical or rudiment of the under part. In proportion as theſe advance oxygen is abſorbed and carbonic acid diſcharged; thus the change is produced gradually, from a farinaceous to a ſaccharine ſubſtance; and after the vegetation has proceeded a certain length, the grain is remarkably ſweet, and has all the qualities of ſugar: it is more ſoluble in water, diſſolves into a viſcid fluid like ſugar and water. As ſoon as the whole has undergone this change, the proceſs of vegetation is ſtopt, by ſcattering it and applying a drying heat; ſo the grain is now changed into a ſaccharine ſubſtance, which is ſoluble to a great degree in cold water, and diſſolves eaſily with the aſſiſtance of a gentle heat. To this change all the purer farinaceous ſubſtances are ſubject, and even the roots of different vegetables, as potatoes.

DCCCCLIV.

Several vegetables are remarkable for their fecula. The 1ſt is potatoes, the feculum of which is eaſily procured by grating them down, or diſſolving by pouring on them a ſufficient quantity of water, in which the feculum is firſt ſuſpended, and then falls to the bottom. The 2d is briony from which, when raſped, the fecculum is ſqueezed out by a preſs. The 3d is the teculum of the caſſava, which undergoes a particular preparation. The 4th is ſago, or the feſiculum of the pith of the palm, and the laſt is the feculum of wheat.

DCCCCLVI.

The 5th principle of vegetables is their ſugar, which is very remarkable in ſeveral reſpects, and the nature of it

is curious to a chemift. It has a pure fweet tafte without any flavour; like other falts, it diffolves freely in water, and is capable of cryftallization, and it refufes to diffolve in fpirit of wine when ftrong, unlefs with the affiftance of heat, and feparates again when the fpirit is allowed to cool; but in fome of the other falts it has the power of refifting fermentation and putrefaction in vegetable fubftances, and this it poffeffes to a confiderable degree; it contains a quantity of carbonic acid, as appears from the effect of burning it with an impyreumatic oil and carbonated hydrogen. Thus its principles are hydrogen, carbon, and oxygen: and thefe are in the proportion of eight parts of the firft, 28 of the fecond, and 64 of the third; and it proves ufeful in the compofition of mortar; added to lime it forms a hard mortar, and makes it more durable, probably by furnifhing carbonic acid, which reftores the lime to a hard calcarious ftone.

DCCCCLVII.

When fugar is oxydated it is converted into oxalic acid, and this is eafily effected by diftilling from it fix parts of nitric acid. It has alfo been fuppofed that fugar was poffeffed of a faponaceous quality, for promoting the union of lime and water, like gum. Dr. Boerhaave confidered this as one of the moft ufeful qualities of fugar, with refpect to medicines and pharmacy; but experience does not confirm this notion. It fhows fome difpofition to promote the mixture of effential oils with water, but they have a confiderable difpofition to unite of themfelves; and fixed oils alfo, when attenuated by repeated diftillations, become fo difpofed; but when we try the fixed oils, we do not find that fugar affifts their union with water.

DCCCCLVIII.

Sugar diffolved in water, and placed in a certain temperature, undergoes a change in its compofition, and is converted by the procefs of fermentation into ardent fpirit.

DCCCCLIX.

The fucceffive formation of the three vegetable prin-

ciples we have hitherto defcribed, is eafier traced than any others. The fap containing the general principles of vegetable matter with fome falts, having lime for their bafe, is changed into gum, which to the general conftituent parts, poffeffes alfo, in addition, a proportion of lime and azote. By the attraction of the two latter principles fecula comes next to be formed; and by the addition of oxygen to this part, and the extraction of the proportion of its carbonic acid, it is converted into fugar. Thus fugar poffeffes an excefs of oxygen, and its production is favoured by a feclufion of the vegetable parts, that contain it from the light.

DCCCCLX.

6. The next principles of vegetables are gluten and albumen. The firft is contained in moft farinaceous grains and roots, along with the fecula and fugar. It is infipid, of a grey colour, is very ductile and elaftic, and refembles the gluten of the animal. It exifts in the beft flour in the proportion of from one-fifth to a third part. It is infoluble in water, and only fo in fmall quantity in alcohol. It is diffolved by different acids, and thefe folutions are again decompofed by the alkalies. The nitric acid, in diffolving it, extricates a confiderable quantity of azote, and its refidue forms oxalic acid. By heat it is fubject to putrefaction, and when decompofed gives out, as its chief product, much ammonia. Hence it appears a compofition of azote with hydrogen and carbon.

DCCCCLXI.

7. Albumen, the other principle, is combined with the former. It is diffolved by the water, by which the flour is decompofed, and feparates, when it is heated, in light flakes. It is foluble in cold water, but coagulates by heat or alcohol. It diffolves in the alkalies, is liable to putrefaction; and when decompofed by heat, affords ammonia.

DCCCCLXII.

The mixture of fecula and fugar with thefe two laft principles in vegetables, gives a juft fuperiority in point

of nourifhment to thofe fubftances that contain them, being already, as it were, fomewhat of an animal nature.

DCCCCLXIII.

8. Oils, the next principle of vegetables, was already examined in the clafs of inflammables, both thofe of an effential and fixed nature, and their general properties of unctuofity and inflammability confidered. Camphor, another product, was alfo claffed under the fame head, being an effential oil, with a larger proportion of carbon.

DCCCCLXIV.

9. Wax came under the fame diftinction, being a variety of the fixed, in the fame manner as camphor is of the effential, oils.

DCCCCLXV.

10. Refins and balfams were treated under the fame divifion, the former being merely an oil rendered concrete by oxygen; the latter, being a refin, with the benzoic acid. A variety of the firft often occurs, termed gum refin, in which an intimate union of the gum and refin takes place.

DCCCCLXVI.

11. Extract, the next vegetable product, has not hitherto been treated under any of the former divifions. It is a dry brown matter, flightly deliquefcent in the air, and foluble in water. It is obtained from the juices of the plants by mechanical preffure, from the plant itfelf, by infufion or decoction, and the fubjecting it to infpiffation. It is equally foluble in water and in alcohol, and it abforbs oxygen, when expofed to the atmofphere, thus leffening its folubility. By oxygenated muriatic acid it is converted into a concrete fubftance of a yellow colour, infoluble in water, and by diftillation it affords an empyreumatic oil and acid, with ammonia. Its conftituent principles are thofe of every vegetable along with azote.

DCCCCLXVII.

12. A peculiar vegetable product falls next to be examined, termed the caoutchouc, or elaftic gum. It is the infpiffated juice of a tree in South America. It is

obtained by incisions in the bark; it is at first thick and milky, and becomes concrete on exposure to the air, from the absorption of oxygen. It is remarkable for its ductility and elasticity, when dry. It is softened by water, is dissolved by the ethers, and by the fixed and essential oils. It is not acted on by the alkalies, but is altered by the sulphuric and nitric acids. It is softened and loses its elasticity by heat. Its elements are the general constituent principles of vegetables with azote.

DCCCCLXVIII.

13. The vegetable principles that come next in succession are the various species of acids already detailed under the head of salts. These acids we found peculiar to certain plants, and also to certain periods of their vegetation. They have all the other vegetable products, a base of carbon and hydrogen, and differ from each other chiefly in the proportion of these principles, and hence their conversion into each other. The oxalic being the one most highly oxygenated, into it the others are changed.

DCCCCLXIX.

14. Alkalies, as well as acids, are also, as we have formerly seen, a vegetable product, and these alkalies are confined to potash and soda. The first is found in all plants that grow at a distance from the sea; the second is found in all the plants that grow in the sea, and in many that grow on land.

DCCCCLXX.

15. Tannin, or the tanning principle, is another peculiar vegetable product. It was formerly considered with the vegetable acids.

DCCCCLXXI.

16. Earth is also present, in a certain proportion, in all vegetables; and the kinds met with are lime, silica, magnesia, and alumine. The two first, however, are the most abundant, particularly lime.

DCCCCLXXII.

17. Metals are occasionally met in vegetable substances.

The principal one is iron, which exiſts in moſt plants Manganeſe and gold have been alſo detected.

DCCCCLXXIII.

18. The aroma of vegetables has been marked as another diſtinct principle for the examination of chemiſtry. Though reſiding generally in the eſſential oil, it is by no means excluſively confined to it, but exiſts as a ſeparate principle, more ſubtle and volatile than eſſential oil, and on which the odour of the latter depends. Hence it is found in plants in which no eſſential oil exiſts, and it is eaſily imparted to water by theſe plants, being readily diſengaged from any plant by a moderate heat.

DCCCCLXXIV.

19. To theſe principles of vegetables may be, laſtly, added the colouring matters. In different vegetables this matter has different chemical properties. It is extracted by different ſolvents; and in its production or application to ſubſtances, it is certain oxygen acts an important part.

DCCCCLXXV.

After this view of the principles of vegetation we are next led to the combinations they form in conſequence of their decompoſition by fermentation.

DCCCCLXXVI.

Fermentation and Putrefaction.

The ſaccharine farinaceous parts of vegetables ar more diſpoſed to undergo a great change by what is called fermentation; the other parts have a diſpoſition to other changes, which are called putrefaction, corruption, or diſſolution. It is proper, therefore, to conſider theſe changes. The diſpoſition is in conſequence of the looſe coheſion of their conſtituent parts.

DCCCCLXXVII.

Vinous Fermentation.

The ſaccharine matter only, and the farinaceous, when converted into ſaccharine by vegetation, can undergo this fermentation; but they muſt be diſſolved in

water, and reduced to fluidity, either naturally or artificially. All the juices of fruits contain a faccharine fubftance diffolved, and they are remarkably prone to this fermentation; but if the matter is not already fluid, as honey, malt, dried fruits, fugar, farina, it muft be diffolved in water; and as fluidity is neceffary, fo the degree of fluidity influences the readinefs and perfection with which this change is performed. If too little water is added there is always a quantity of vegetable matter remaining unchanged. If we dilute more largely, the fermentation is more quick and rapid, and has a greater tendency to run into the acetous.

DCCCCLXXVIII.

Another circumftance which influences the quicknefs and perfection of this change is the temperature of heat. A certain degree of heat is as neceffary as the dilution in water; a moderate temperature anfwers the beft. If the heat is too great it is apt to pafs from the firft into the fecond ftage; if too little, it ftops it. The phenomena which attend and fucceed one another are thefe; it is eafy to obferve them by making the experiment upon a moderate quantity of faccharine matter, fermented in water, and done in a glafs veffel. There is firft an abforption of oxygen, and the feparation of an elaftic aerial matter, or carbonic acid, from all parts of the fluid, which uniting into minute globules, arifes from all parts towards the furface, producing a motion in all the parts, and a fenfible hiffing noife, and it foon forms a fcum or froth, which retains for a while the little globules of air. The feparation of it produces a remarkable change in the denfity or weight of the fermenting liquor; the vegetable fluid, when fermenting, muft fuffer fome lofs of evaporation, which fhould concentrate the folid matter, and render it a heavier fluid; but inftead of being denfer it is lighter. Upon being put into the fame veffel with water, it will fwim upon the furface of the water, whereas before fermentation it is heavier, containing a quantity of faccharine matter, which has a denfity greatly fuperior to that of pure water.

At the ſame time that carbonic acid ariſes from the fluids, there is a ſeparation of ſome ſolid ſubſtance, which appears floating throughout the liquor, and renders it muddy; and this matter ſeparating, a part gradually ſettles, and forms the ſediment called lees, and a part buoyed up to the ſurface by the air, gives a firmneſs and ſolidity to the ſcum formed by the air.

At the ſame time that this goes on there is a gentle degree of heat; the fluid is a little warmer than the ſurrounding air.

DCCCCLXXIX.

After theſe phenomena have continued for a few days, according to the degree of heat, all the effects of the fermentation begin to abate; the heat of the liquor diminiſhes; the agitation of the fluid, in conſequence of the ſeparation of the carbonic acid, is leſs conſiderable, the liquor clears, and the ſcum falls to the bottom, unleſs there is ſomething to ſupport it. The muddineſs at firſt was chiefly occaſioned by the conſtant riſing of the carbonic acid driving up the feculent particles, which are ſeparated by the fermentation; and as ſoon as the ſeparation of the carbonic acid ceaſes, theſe particles gradually ſettle, and the remaining carbon and hydrogen combines. This is the caſe eſpecially in the fermenting of beer. In the management of wine, a particular art is neceſſary to prevent the ſcum from falling; they throw into the veſſel, which is large, the ſtalks and huſks of the grapes, which remain after the juice is ſqueezed out. Theſe ſwim upon the ſurface, and entangle a great quantity of the feculent matter, as it ſeparates, ſo as to form a thick and and firm covering to the fermented liquor, which prevents too great abſorption of oxygen and conſequent diſſipation of the carbonic acid, by preſerving its ſurface from the contact of the air: ſo the wine turns out the ſtronger, and a great quantity of that feculent matter thus entangled is kept there, and prevented from ſettling at the bottom, ſo that the greateſt quantity of the liquor can be drawn off clear below. When we now examine the liquor we

find a remarkable change; the odour and tafte is different. Before it was fweet, with little odour; it had a certain fweetnefs and flatnefs: but after the fermentation has proceeded fo far, it has a very agreeable odour, and the tafte is very grateful to the palate, but pungent; it is poffeffed, befides, of an inebriating quality which it was free from before; and we find that it now affords by diftillation a fpirit of wine, a fourifh, feculent, watery liquor remaining behind; whereas before the firft vapours are purely watery, a thick fyrupy matter remaining, which contains the fugar diffolved in water. The fermentation, carried on fo far, is called the vinous fermentation, or firft ftage, and the liquor fo produced is called wine, or vinous liquor, being a new combination of the remaining carbon and hydrogen of the fugar; and if it is preferved moderately cool in a glafs veffel, it will continue for a long time, but ftill with a flow progrefs towards the next ftate to which it has a tendency. It depofits a fmall quantity of the feculent matter, which it depofited fo plentifully during the fermentation, and a quantity of tartar. In confequence of this the wine improves in its quality, and is found to be much more perfect than it was at the firft; but after this time it begins to decay, and to lofe its perfection, which fhows that there is a conftant and gradual progrefs towards the next ftage, and which is neceffary to the perfection of wine, and other fermenting liquors.

We muft not confider the wine as in a quiefcent ftate; there is ftill a fermentation going on, though in a flow and imperceptible manner; and it is probable that the perfection of the liquor depends upon the progrefs of this fermentation; for if it is checked too much the liquor becomes vapid, as when it is affected by thunder. Again, if it is kept too warm, the flow fermentation goes on rather too faft, and it makes too faft a progrefs towards the acetous fermentation.

What then are the circumftances which occafion the fudden check to the violent fermentation? why it fhould

ſtop as ſoon as it comes to the ſtate of wine, without proceeding immediately to the acetous fermentation? It is clear, by the new combination of the principles, or the quantity of ardent ſpirit produced in it; this added to the vegetable juice, the moſt diſpoſed to fermentation, will effectually prevent its undergoing this change; or added in ſmall quantity to a vegetable liquor that has too much diſpoſition this way, it will check it in a certain degree, ſo as to render the fermentation more regular; as ſoon then as it comes to abound in the liquor it proves an obſtacle to the further progreſs; and vegetable fluids which are too rich will never ferment ſo perfectly, and therefore all ſtrong wines are attended with a certain degree of ſweetneſs, a great quantity of the matter not being fermented; for as ſoon as a quantity is changed into ardent ſpirit, that proves an obſtacle to the fermentation of the reſt of the ſaccharine matter; therefore to have a liquor fermented to the moſt perfect degree, it muſt be diluted to a certain degree. And further, the other circumſtances moſt neceſſary to a perfect fermentation are, a moderate temperature of heat, and a great attention to the cleanlineſs of the veſſels; the ſlighteſt taint or odour reſiding in the veſſels is communicated to the liquor, and diffuſed through a great quantity of it during the proceſs.

DCCCCLXXX.

Acetous Fermentation.

If the liquor which has undergone the vinous fermentation be kept in a temperature of 75 to 80 of F. it proceeds to what is called the acetous change.

The change here is not remarkable; there is merely an abſorption of oxygen, and no carbonic acid given out, ſo that the alcohol becomes oxygenated, a groſs unctuous matter ſeparates to the bottom, the liquor in conſequence loſes its vinous taſte and flavour, it becomes ſour, and on diſtillation affords no alcohol; it affords only a quantity of water; it is the acetous acid, formerly conſidered; and if this is diſtilled it may be kept in this ſtate, when ſepa-

rated from the unctuous matter which preserves it from the putrid change; but kept with this unctuous matter it becomes dark coloured, loses its sour taste, and acquires an offensive one, and now it affords only an ammonia, and this is called the putrefactive fermentation.

DCCCCLXXXI.

Thus from the progress it appears that the same substance which is capable of the vinous, is also capable of the acetous and putrefactive fermentation, and we may say it has always a tendency that way, and that it is impossible to induce the first without a mixture of the second, or the second without a mixture of the third; for every wine is a little acid, and therefore there are few vinegars without some slight disposition towards putrefaction, in which there is not a little volatile alkali produced, though it is neutralized by the acid, which predominates.

At the same time it is to be understood that the acid change is not confined to substances which have previously undergone the vinous or the putrefactive fermentation, or the latter to those which have undergone the acetous. All vegetable substances have, more or less, a tendency to the putrid, and a great number of them are capable of the acetous; but the number of those which are capable of the vinous is not considerable, and those which are capable of the acetous will run into the putrid, in circumstances in which they cannot undergo the vinous; the circumstances necessary to which do not readily occur, for they must be reduced to a state of perfect fluidity with water, and this does not readily happen unless it be done on purpose, at least that a large quantity is collected fit for undergoing this change in a proper state of fluidity. The acetous change does not require such a complete degree of dissolution. Such a quantity of water united with a vegetable substance as will merely give it softness, will render it capable of acescency; so flour made into a paste will become sour, but more water must be applied, and it must be dissolved perfectly to fit it for the vinous; for the

putrid, again, more dampnefs is fufficient: fo the moft folid and durable parts of vegetables, as the wood is liable to a change of this kind; the progrefs is flow and gradual, but it is effectual in totally diffolving their texture. In fome cafes, where the fubjects are a little more fucculent, and fo fpongy that they preferve the heat produced by the putrefaction, this putrid change goes on with fuch a rapidity as to produce a great quantity of heat; and in this way hay-ftacks, &c. put up too damp, fuffer the putrid change fo faft that a quantity of inflammable vapours is produced, which fometimes occafions them to take fire. When the vegetable fubftances which undergo the putrid change are naturally folid and firm, the effect of it at firft is to render them tender and friable; and as the change proceeds, they are quite difunited, diffolved, and broken down into a powder, and during this change the vegetable fubftance fuffers a great lofs by evaporation, a great part of it being volatilized. What remains is a fmall quantity of an earthy fubftance, which is faid to have fome of the qualities of clay, forming a plaftic mafs, when mixed with a fmall quantity of water.

DCCCCLXXXII.

The vapours which exhale during this procefs have alfo a mufty, or more difagreeable fmell; the ammonia is difcoverable when vegetable fubftances are putrified on purpofe; for in the common manner the change goes on flowly, and if expofed to the air the volatile alkali may be diffipated, and fo much diffufed as to become infenfible; but when the fubftances are amaffed together, confined, and loaded by a confiderable weight, the putrefaction goes on to a more perfect degree, and the ammonia can be obtained by diftillation. The effects of thefe mufty vapours are to render the combination of lead with the vegetable acids of a black colour. Silver too is tarnifhed by it; and where thefe vapours are produced in large quantity, as in a ftack of hay, they fhow themfelves in flame, fetting the ftack on fire. And on other occafions the efcape difcovers itfelf by an

emiſſion of light: ſo rotten wood appears luminous in the dark.

DCCCCLXXXIII.

It further remains to be obſerved, that all theſe changes are greatly promoted by the addition of ferments. A ferment is a ſubſtance of the ſame nature which has already undergone ſome degree of the change which is to be introduced upon a greater quantity of the ſame ſort of matter. In this country we are moſt accuſtomed with the effect of theſe in the manufactory of vinous liquors, a quantity of the ſcum formed on the ſurface by the riſing of the carbonic acid and mixture of the feculent parts of the matter; or a little of the liquor itſelf added to a freſh matter will make a beginning, and occaſion the whole to run through the vinous fermentation in a regular manner. And it would be impoſſible, without matter already in a ſtate of fermentation, to bring the farinaceous into the vinous fermentation. Without this it is diſpoſed to run into the acetous when diluted with water; and even when it is malted, or changed into a ſaccharine ſubſtance. Ferments have been thought capable not only of enduring fermentation, but of inducing a change in the nature of the liquor which the fermentation produces; and it has been propoſed as an improvement in the art, to take ferments from other liquors, from ſome of a higher or more delicate flavour; as from fermenting wine to be added to an infuſion of malt, that it may diſpoſe it to be changed into a liquor approaching more in taſte and flavour to wine than if the fermentation was brought on by means of the ordinary ferment: but there are no facts in proof of this, otherwiſe than that an acetous ferment will determine a fermentible ſubſtance to run faſter into the acetous ſtate than one from the vinous, and in the ſame manner of the putrid; ſo thoſe employed in the manufactory of vinegar from the infuſion of malt, find it of conſequence to preſerve the veſſels long uſed; the ſeaſoning received from the conſtant uſe renders them much fitter for producing the change of freſh matter into good vinegar than any other veſſels.

And with regard to the vinous fermentation in the infusion of the ſugar cane, by which the vinous liquor is obtained that afterwards affords rum; it is of conſequence to waſh the veſſels with a ſmall quantity of liquor which has been fermented before, or of the rum which has been diſtilled, whereby the liquor affords a quantity of the ſpirit; ſo it ſeems plain that a vinous fermentation will diſpoſe a ſubſtance, capable of the vinous, more readily to undergo that fermentation; and in ſome caſes will bring it on where it would not have been diſpoſed; whereas the acetous ferment gives a ſtronger diſpoſition to run immediatly into the acetous. And the ſame thing holds with regard to the putrid; but ſtill the acetous ferment will not hinder a ſubſtance which is ſtrongly diſpoſed to the vinous fermentation from becoming in ſome degree vinous. In like manner the putrid ferment will often bring on the vinous and acetous fermentation, though with a ſtronger diſpoſition to the putrid: ſo with regard to the alimentary mixtures, a ſmall quantity of putrid matter is found to bring on a ſmall degree of vinous fermentation, inſtead of the putrid. But it is not imagined that a ferment will change the nature of the fermentation, occaſioning the ſubſtance to produce a different ſort of vinous liquor from what it otherwiſe would have done. Perhaps what may have given riſe to this opinion is this, that any flavour attending a ferment is wonderfully diffuſed through the liquor to which the ferment is added.

DCCCCLXXXIV.

From this account of fermentation will be eaſily underſtood the effect of ſome circumſtances which retard or prevent it. The moſt effectual way of preventing theſe changes in vegetable ſubſtances is to diſſipate their watery parts, and preſerve them dry. Accordingly, many vegetable ſubſtances which are very prone to theſe changes, are preſerved by this method; ſo roots of various kinds are preſerved in this way, and in this way the botaniſts have learned to preſerve their plants, by drying them quickly, even ſo as to retain their colour in a wonderful

degree of perfection. There are ſome other means which have a great effect, the nature of which is not ſo eaſily explained as ſpirit of wine, which gives a check to the vinous fermentation: common ſalt, ſugar, nitre, acids, and other ſolid ſubſtances, eſpecially the volatile ſulphureous acid, which is uſed in the wine countries, have this effect. It is alſo proper on many occaſions to exclude the air, or even to extract it by the air pump: heating the ſubſtances to the degree of boiling water, produces ſome change in the combination of their plants, which facilitates their preſervation from this change.

DCCCCLXXXV.

The electrical fluid, lightening, thunder, &c. totally check fermentation; and the common remedy is to put a lump of iron upon the caſk; but it is more proper to fix a rod of iron at ſome diſtance, that the electrical fluid may run entirely off.

DCCCCLXXXVI.

Theſe different kinds of inteſtine motion, or fermentation, require attention, before we proceed to conſider animal ſubſtances, as the change of the vegetable into the animal matter has been ſuppoſed to depend in ſome meaſure upon a diſpoſition which the vegetable has to undergo ſome of theſe ſpontaneous changes or decompoſitions.

DCCCCLXXXVII.

From this view the vegetable principles, as applied to medicine, become naturally divided into two kinds, dietetic and pharmaceutical. The former includes the fecula, ſugar, albumen, gluten, and fixed oil; the latter comprehends all the others that admit application. The firſt we have detailed at length in a ſeparate publication (Vide Treatiſe on Diet); the latter has been chiefly examined in the claſs of inflammables, (p. 121.)

DCCCCLXXXVIII.

Animal Subſtances.

All animals are fed upon vegetables, either directly or through the intervention of other animals. No part of

the ſubſtances of animals is from any other ſource except water. The ſmall quantity of ſalt uſed by man, and ſome other animals, ſeems to be neceſſary only as a ſeaſoning, or as a ſtimulus, and not as affording any thing nutritious: ſo animal matter, when ſubjected to trials, is reſolved into the ſame principles as the vegetable matter, with a large proportion of ammonia, and generally fœtid gaſes, conſiſting of hydrogen, azote, ſulphur, and phoſphorus; the fœtid reſidue conſiſting of iron and phoſphoric ſalts.

But though the principles of animal and vegetable ſubſtances are at the bottom the ſame, they are combined in a different manner: the compound is very ſenſibly different. There is hardly any ſuch a thing among animal ſubſtances as the vinous or acetous fermentation, they run remarkably faſt to the putrid; we do obſerve ſome receiving the aceſcent, as taken notice of in the acids; but it is rare.

DCCCCLXXXIX.

The difference in the principles of animal matters from thoſe of vegetables lies chiefly in their containing azote, generally phoſphorus, and not unfrequently ſulphur. The azote and phoſphorus give the tendency to decompoſition which diſtinguiſh the animal over the vegetable body, and the effect of this decompoſition is the production of ammonia, Pruſſic acid, and other matters.

Animal ſubſtances exceed alſo in their proportion of hydrogen, compared with vegetables. Hydrogen, therefore, forms their principal baſe, as carbon is of vegetables; and as animals live on vegetables, the changes producing theſe new principles are the effect of the action of their functions of digeſtion, reſpiration, and ſecretion.

The principles they derive from vegetables are clear. Azote, it is probable, is drawn from the atmoſphere by the animal; phoſphorus ſeems the product of animalization, drawn from the vegetable origin; and all their other principles are productions from the ſame ſource.

DCCCCXC.

The putrefaction to which animal subftances are remarkably prone, compared with vegetable matters, has made it an object to contrive means for preventing it. In general they are preferved by means fimilar to thofe ufed for the prefervation of vegetable fubftances. In order to preferve a fucculent animal fubftance from decay, for only a fhort time, the circumftances moft neceffary are coolnefs and drynefs of the air which furrounds them, and efpecially the wiping off any fmall quantity of corrupted matter which collects on the part next in contact with the air, in which the corruption takes place firft, for this proves a ferment, promoting the corruption of the neighbouring parts; fo it is of confequence to feparate thefe parts in which the change is begun: but this method will only ferve for a fhort time.

DCCCCXCI.

Another method is by exficcation, by diffipating their moifture, whereby they may be kept a long time in dry air: or if this is inconvenient or improper for the purpofe in view, we employ antifeptics. Common falt, in large quantity, anfwers the purpofe; nitre is ftill more powerful, but we cannot ufe it fo freely; fugar too is very powerful, but it is feldom ufed, on account of its price.

DCCCCXCII.

On ftudying this fubject more particularly, it is found, by experiments, that all the falts have more or lefs of an antifeptic power, except common falt in fmall quantity, which rather promotes the corruption of animal fubftances; but the fixed volatile alkalies, which are confidered as highly putrefcent, are now acknowledged to be antifeptic, as are alfo bitters, aftringents, and aromatics; and the bark is very remarkable for its power in preferving animal fubftances; the camphor is found to be very powerful, and therefore given in fmall dofes in putrid difeafes. But above all, the nitrous gas feems to be the moft powerful, according to Prieftly's experiments.

DCCCCXCIII.

The lift of feptics, or thofe fubftances which promote putrefaction, is much fhorter. Nothing is found to have the tendency but putrid ferment; a maf. of putrid matter, already in a putrid ftate; the calcarious, and other abforbent earths; magnefia, particularly; and a fmall quantity of common falt.

DCCCCXCIV.

From this general view of the animal matter we next confider the variety of it which is to be found in the bodies of animals, and this variety may be divided into *folids* and *fluids*.

DCCCCXCV.

Animal Solids.

The folids do not differ greatly, except in the proportion of their earthy matter. In animal, as well as vegetable fubftances, earth feems to be the principle of folidity; the hardeft parts are the bones and horny parts; next to thefe are the cartilages, next to thefe the tendons and ligaments, then the mufcles; and in general they have more earth in their compofition in proportion to their folidity. Thefe parts alfo afford a large proportion of ammonia, which arifes mingled with a naufeous empyreumatic oil; fo it is feparated, in fome meafure, by repeated rectifications, but never completely. It always retains fome degree of fœtid odour, as in fal cornu cervi. The oil itfelf, fubjected to repeated rectifications, turns out more fubtile and volatile, and lefs offenfive, and feems to be more efficacious in promoting fweat and calming convulfive motions; but the procefs is fo tedious and difagreeable, that it is hardly to be met with.

DCCCCXCVI.

Water being boiled with animal fubftances, extracts a confiderable part of their fubftance, which thickens as the vegetable gums do: when the liquor is allowed to cool, forms a ftrong jelly; and when a confiderable quantity of this is diffolved, it proves much more adhefive than the vegetable gums.

DCCCCXCVII.

With regard to the other ſolvents on the animal ſolids there are none which have any remarkable effect but the corroſive ſalts, of the acid and alkaline kind, and quick-lime. The acid attracts the earthy parts more ſtrongly from the alkaline ſalts which many of them contain. We have an example of their acting upon the earthy parts, without affecting the other parts, in ſome elegant anatomical preparations, as of the teeth and of the jaw-bone, and other bones in the body: theſe are obtained by injecting the veſſels, and afterwards ſteeping them ſome time in a diluted foſſil acid, particularly the muriatic acid; and after ſome time the whole of the earthy matter is diſſolved, the glutinous part remaining and retaining the form, it becomes tranſparent like glaſs, ſo that the veſſels can be ſeen paſſing through the internal parts. If the acids applied are ſtronger, the parts are completely diſſolved; they take up both the earthy matter and the gelatinous; and in this way we have ſome elegant anatomical preparations. After any part of the body is injected with wax, it is ſteeped in the ſtrongeſt ſpirit of ſalt, which totally diſſolves all the animal matter, leaving nothing but the wax molded in the internal cavities of the veſſels, in ſuch fine filaments that it requires a microſcope ſometimes to ſee them. The muriatic acid anſwers beſt, as being a very powerful ſolvent of animal matter, and leſs liable to act upon the inflammable matter of the wax than the nitrous, or vitriolic, or the cauſtic alkalies.

DCCCCXCVIII.

The bones are compoſed of cartilage, which conſiſts almoſt entirely of gelatin, of phoſphate of lime, carbonate of lime, and ſulphate of lime. By boiling water under an increaſed preſſure, as in the digeſtor, the gelatin is diſſolved. By maceration in an acid, the phoſphate of lime becomes extracted, and the parenchyma of the bone is left. By decompoſition by heat, ammonia, empyreumatic oil, and carbonated hydrogen, are produced.

DCCCCXCIX.

The baſe of the muſcular fibre is fibrine, a white, in-

fipid, inelaftic matter, which heated with nitric acid gives out azotic gas, and is converted into malic and oxalic acid. The macerating water contains the colouring matter of the blood, gelatin, albumen, faline matter, and fat. The proportion of gelatin exceeds, in the young mufcular fibre, the proportion of fibrine in that of age. Decompofed by heat the common products of animal matter appear along with a peculiar acid, formerly treated, the zoonic.

M.

Fat we already confidered as of the fame nature with the vegetable expreft oils. It is infipid, inodorous, infoluble in water, and in alcohol, and with alkalies combines fo as to form foap. By the abforption of oxygen from the air it acquires acidity; and a peculiar acid, the febacic, is formed. It is oxydated by the acids, particularly the nitric. When decompofed by heat it affords an acid liquor, an empyreumatic oil, and carbonated hydrogen. It oxydates feveral of the metals, when combined with it in the form of ointment.

MI.

The pulpy matter of the brain approaches nearly to albumen; and it is mixed with phofphate of lime, foda, and ammonia.

MII.

The other folid parts, viz. membrane, ligment, tendon, and cartilage, confift of gelatin rendered concrete by a flight degree of oxydation, and they differ from bone chiefly from the latter poffeffing a greater quantity of phofphate of lime in their compofition. Of thefe parts the epidermis feems to poffefs the higheft degree of oxydation.

MIII.

Animal Fluids.

With regard to the animal fluids, we can here find a diftinction between a general fluid and others prepared from its fecretion.

The blood is not only the fame in different parts, but even in different animals. Examined as taken from

man, it appears a homogeneous fluid, a little heavier than water, ſo having a tendency to the bottom, but readily mixing with water of the ſame temperature; and further, it conſiſts moſtly of water.

To underſtand its nature more particularly, it is neceſſary to examine it, to attend to a number of parts which are eaſily ſeparable without the application of a ſtrong heat, and to examine their qualities.

MIV.

If blood is barely allowed to ſtand at reſt for ſome time, we ſee theſe parts; though at firſt it appears a perfect fluid to the naked eye, it is not ſo in reality. The microſcope diſcovers it to be, even in the natural ſtate, a mixture, having a certain degree of fluidity, with a matter having a certain degree of ſolidity. It is formed into minute globules, each of which conſiſts of a flatted particle and reddiſh, ſo as to produce a red when united. The coagulability of the blood is known, when expoſed to the air, and its ſeparation into ſerum and craſſamentum. This was formerly imputed to the action of cold, but it has been found that it does not depend upon cold principally, but upon the influence of the contact of the air, for it has been found that it coagulated better when it was kept pretty warm.

MV.

The properties of the ſerum come firſt into review. It is a yellow, tranſparent, ſub-viſcid fluid; to the taſte and ſmell it has no appearance of a ſeparate acid or alkali, as has been ſuppoſed by ſome reaſoners in medicine. It preſerves its fluidity in the ordinary heat of the air, but contains a quantity of matter or albumen, which becomes ſolid in about 160° of Farenheit. The effect of this is to convert the whole of the ſerum into a jelly, which is produced by the fermentation of a number of minute threads or fibres which the coagulated part forms throughout the whole of the fluid that coagulates the remaining fluid, like the fibres of a ſponge. That there is a quantity of water ſtill appears fluid when we

take a quantity of it and fuſpend it in the air, the parts contract, and ſqueeze a quantity of water out of their pores. It would ſeem, therefore, that the coagulable part has a diſpoſition to coagulate into a recticular texture, or ſpongy maſs, and we can underſtand the uſe of this part of the blood; or if the albumen ovi in the clarification of ſugar and common ſalt, as the heat increaſes to 160°, or a little more, according to the degree of dilution, it ſeparates into fibres throughout the whole of the fluid, and forms a ſubtile net-work. As the heat increaſes, this fibrous matter is gradually thrown up to the ſurface, partly too by the ſeparation of the air; and while it is compacted into a denſer body, it entangles in its maſſes all the lighter floating impurities; ſo having collected theſe, it appears in the form of a dark impure ſcum, and the liquor below is a clear tranſparent liquor.

MVI.

Beſides this action of heat it is affected by ſeveral chemical liquors in the ſame manner, as by ſtrong ſpirit of wine, mineral acids, and their combination with weak earths, as allum, or ſome of the metallic ſalts. The acetous acid is rather a diluent, and a preventer of the coagulation of the blood, in its ordinary diluted ſtate; but when it is brought near in ſtrength to the mineral acids, it produces a ſemi-coagulation, though not altogether ſo ſoon. The cruor, at the beginning, occupies the whole maſs, ſo as to give the whole the appearance of a ſoft jelly; but contracting in all its dimenſions, it comes to be ſurrounded with ſerum, preſerving the form of the veſſel. This maſs is a little harder than the ſerum, ſo when thoroughly melted it ſinks, but the upper ſurface being left dry, and contracting more than the under, forms into a concavity, and floats upon the ſurface, as any hollow body or boat does upon water.

MVII.

A more particular examination of this maſs ſhows that it is chiefly compoſed of red globules, few remaining in the ſerum; and its ſolid conſiſtency has been attributed

to the attraction of these globules: but if they have any attraction for one another, it is very inconsiderable, and is not the cause of the firm concretion. The solidity evidently depends upon the existence of a third substance, the coagulable lymph, or animal gluten or zebrine. This matter is at first perfectly fluid, but it has the same tendency to coagulation as the serum, but in a much greater degree: so it coagulates in an inferior degree of heat, and tends to coagulation even by rest, especially if the air is admitted, which greatly promotes its coagulation. It seems however to be very much akin to the coagulable part of the serum, the parts are formed into minute filaments of a reticular texture that entangle the fluid parts of the blood in their pores; this reticular texture is at first equally diffused, and gives the whole the consistence of a jelly. But afterwards the lymph slowly contracts, squeezing the serum out of its pores, but retaining the red globules, which it draws together, and brings them into closer contact with one another. Upon this part the coagulation of the cruor depends: so when we expose a mass of the cruor to a stream of water, it carries away all the red globules, and leaves a gelatinous mass on the surface of the blood, which appears to have been the cause of the solidity of the cruor; and the red globules being so easily carried off, show that they did not contribute to its solidity.

MVIII.

Another manner of discovering it is this, as soon as the blood is let, if it is stirred with a bundle of small sticks, it will prevent its coagulation, the blood remains fluid, and examining the sticks we find the coagulable lymph concreted into a membraneous matter on their surface; so we only prevent it from forming that subtile fibrous texture which is otherwise diffused though the whole mass, and force it to concrete on the surface of the sticks. In this way we have the coagulable matter perfectly colourless, while the red globules are mixed with the serum, and in a fluid state.

MIX.

Another experiment to obtain this part is by receiving it into a phial from the vein, and corking the phial, then agitating it with the air, the air is applied to all the parts more equally, and produces the whole effect of coagulation; but not coagulating in a regular manner it does not entangle the red globules, so they continue by themselves, and the gluten is formed into fibres or membraneous masses, resembling a bit of flesh, and we can see the coagulation by receiving the blood into a quantity of warm water, and the red globules are diffused through the water, and give a tinge to it, while the gluten concretes into fibres like cobwebs, which can be collected. In inflammatory diseases this coagulable lymph is more easily distinguishable from the rest of the blood: when it is let in a full stream into a vessel of a globular form, the upper part of it becomes of a whitish colour, like tallow imperfectly melted, or when it is passing from a state of fusion to a state of solidity. This is occasioned by the substance of the red globules, and from its being occupied chiefly by the coagulable part, which concretes and gives firmness and density to the upper part of the blood. This appearance, which is so remarkable in inflammatory diseases, has given occasion to a great many attempts to explain it; but it is not easy to give a full and satisfactory account of it.

MX.

Some of the phenomena with respect to the blood can be explained from the nature of this fluid, and the circumstances which are found to promote or retard its coagulation. The blood does not show this so readily if it runs slowly from the orifice, and it is not so apt to appear in the blood last drawn from the vein as in that which is first drawn. This is accounted for from an alteration in the action of the vessels; that in general the more vigorous their action is, the coagulation is so much the later. And since the pulse is weakened even during the course of the blood letting, and the action of the vessel diminished, the blood is disposed to coagulate

ſo much the ſooner; ſo there is leſs time for the ſeparation of the red globules. It is probable alſo that the greater cooling of it, the diminution of its heat muſt have a tendency to give the ſerum a thicker conſiſtence, and diſpoſe the blood leſs for the regular ſeparation.

MXI.

With regard to the action of acids and alkalies upon the blood, ſome of the ſaline ſubſtances have been found to produce very remarkable effects upon it. Some of the neutral ſalts prevent the coagulation, ſo they preſerve it fluid, as Glauber's ſalt, common ſalt, &c. Theſe being added to the blood, preſerve it fluid, and the red globules ſubſide; and pouring off the part which is free of globules, and diluting it with water, it recovers its power of coagulating; ſo we can ſee the coagulation of the gluten quite free from the red globules. Other ſaline compounds, again, promote the coagulation of the blood.

MXII.

The only remaining part is the red globules: the nature of theſe is ſtill an object worthy of farther enquiry, though their colour is allowed to depend on a ſmall proportion of iron, in a ſtate of oxydation. They can be diſſolved in water, but not in ſpirit of wine or oils; or adding a ſmall quantity of a neutral ſalt to water, as muriate of ammonia, they continue ſeparate, retaining their uſual form; but mixed with pure water they give a tranſparent red tinge to it, and the globules are completely diſſolved.

MXIII.

Thus the blood is compoſed of three principles, gelatin, albumen, and fibrine, with oxyd of iron and a few neutral ſalts, having ſoda and lime for their baſe; and from theſe principles this fluid, and of courſe all the other parts of animals, are formed. It partakes accordingly of all the properties which diſtinguiſh theſe principles. It ſuffers coagulation by heat, by alcohol, and by acids; an alteration of its colour comes from the application of the gaſes. When decompoſed by heat it

affords the ſame products as its ſeparate principles, viz. empyreumatic oil, carbonate of ammonia, carbonated and ſulphurated hydrogen, Pruſſic acid; while from the macerated maſs remaining is procured phoſphate of ſoda and lime, carbonate of lime, and oxyd of iron.

MXIV.

On the change the blood acquires by the application of the gaſes, the important function of reſpiration depends. The blood tranſmitted to the heart from the veins is of a dark red colour; the blood tranſmitted from the lungs to the heart has a florid red appearance. Theſe changes depend, as we ſhall afterwards trace, on the abſorption of vital air, and the ſeparation of carbonic acid and hydrogen in return.

MXV.

The effects of putrefaction upon the blood deſerve alſo attention. The diſpoſition to coagulate is diminiſhed or deſtroyed by it. This has been obſerved to take place to a certain degree in the living body, as in the ſcurvy and putrid fevers, though there is a debility and other circumſtances moſt favourable for the coagulation. As the putrefaction advances to a greater degree it becomes thinner, and emits a diſagreeable ſmell from the ammoniacal gas. A groſs feculent ſediment falls to the bottom, and the greateſt part of the maſs is volatilized. When the putrefaction is carried farther all the uſual effects follow which attend the putrefaction of other animal ſubſtances. Some experiments have been made upon the different ſubſtances which compoſed the blood. When the cruor is putrified, it aſſumes a black brown colour; and when this is diluted with water, it gives a colour like moſs water. This has occaſioned a miſtake with regard to the blood, and has made it to be conſidered as a fact that the cruor, when infuſed in water, is reſolved entirely into ſerum; but there is no ſuch change; though the cruor be diluted it ſtill retains its red colour, and tinges the water in proportion to the quantity. It is only after a certain degree of putrefaction has taken place that the red colour diſappears.

MXVI.

When the ſerum is putrified by itſelf, it aſſumes a green colour, and depoſits a quantity of ſediment at the bottom, which has preciſely the appearance of pus in ulcers, and every quality of it. Gaber obtained pus from the coagulable part of the blood. The coagulable lymph produces a purulent matter of the ſame kind. Thus many appearances in ulcers and abſceſſes have been explained entirely upon this view of the nature of pus, or its being formed from the coagulable part. The green colour too, which we obſerve on dead bodies, is accounted for from the ſerum aſſuming this colour when it firſt undergoes this change. We alſo obſerve ſomething of that green colour in the ſcurvy, and the high-coloured urine in inflammatory diſeaſes partly proceeds from a diſſolution of ſome part of the red globules in conſequence of a degree of putrefaction; and when the putrefaction riſes higher in putrid diſeaſes, the urine aſſumes a brown colour, like that given to water by the cruor when putrid.

MXVII.

We are now to pay attention to the variety of ſecreted animal fluids prepared from the blood by particular organs in different parts of the body.

Theſe naturally divide themſelves into two claſſes, the excrementitious and uſeful ſecreted fluids, or thoſe which are thrown out as noxious or redundant, and thoſe prepared to ſerve ſome uſeful purpoſes for which they are fitted by their natural and uſeful qualities. The neceſſity of the firſt kind ariſes from the periſhable nature of the materials which compoſe the bodies of animals, eſpecially the warm animals, which are making a conſtant progreſs to decay, and a tendency to putrefaction takes place in the living body; but the parts which have undergone the leaſt change to a ſtate of corruption are ſeparated from the reſt and thrown out, and their place ſupplied by freſh particles from the blood. Theſe ſecretions are three; the perſpiration from the ſkin, the ſecretion of urine, and the evacuation by the inteſtines.

MXVIII.

By the perſpiration from the ſurface of the body is thrown out a ſubtle and volatile excretion, conſiſting of carbonic acid on one hand, and when more copious of lymph and ſaline matter, diluted with a conſiderable quantity of water. The firſt is thrown out in the form of a perfect vapour, in ſmall quantity, and therefore inviſible, but has become viſible occaſionally in ſubterraneous caverns, where the air is cold and damp. At times this diſcharge by the ſkin gives a perceptible odour, though not in general to us, our organs of ſmell are so dull; but dogs, in which that organ is more complete, can diſcern the odour very completely, ſo as not only to diſtinguiſh one ſpecies of animals from another, but one individual from every other of the ſame ſpecies: ſo they can trace their maſter through a croud; or when they [illegible] an animal, they will follow it, though it makes through a number of others of the ſame kind. This ſhows that there are peculiar matters contained in the perſpiration, probably ſaline ſubſtances, and this is certainly attended with ſome of the more highly attenuated oily matter combined with water in a certain manner, as appears in fevers, and ſome other diſeaſes in which the fluids are more corrupted, or the more corrupted parts are accumulated by the perſpiration being obſtructed. When this again is reſtored the patient has frequently a ſtrong ſmell, and the vapour from the particular parts of the body has a ſtrong ſmell, in many conſtitutions, in a healthy ſtate. There are employments too, and ways of life, which give a difference, as in thoſe who manufacture glaſs: in conſequence of the great heat their perſpiration is more copious, and by means of it much groſſer ſubſtances are thrown out than in ordinary caſes. Their linen is manifeſtly loaded with a conſiderable quantity of ſaline matter, which does not readily evaporate, but is conſiderably fixed.

MXIX.

The next of theſe ſecretions is the urine, which waſhes out the more groſs ſubſtances. There is, however, ſome

relation between this ſecretion and the perſpiration, the one ſupplying the place of the other, in ſome meaſure and for ſome time, but imperfectly, and not with the continuance of health. Where a total ſtoppage of the urine for days is occaſionally met with under diſeaſe, though the ſecretion of the ſkin and lungs undoubtedly ſupply its place, in ſome meaſure, yet a number of ſymptoms come on, from the retention of ſome of the parts of the urine within the body, as ſtupor, itching of the ſkin, and eruptions upon it, from ſome parts being ſent to the ſkin which are too groſs or irritating to paſs by it; and where the ſecretion of the urine is deficient, it is generally attended with theſe conſequences, eruptions of a fiery nature, which, if the ſtoppage is continued, ſhow a ſtrong diſpoſition to mortification. The urine, therefore, from this circumſtance, that its place cannot be totally ſupplied, and from the ſenſible qualities of the ſecreted fluid, is evidently conſiderably different from the perſpirable matter. This is apparent when we analize this fluid. When firſt diſcharged it is tranſparent, its colour pale yellow, its ſmell peculiar, its taſte ſaline and nauſeous. Examined at its firſt emiſſion it is found ſlightly acid; but ammonia being ſoon evolved, it acquires an alkaline nature. On cooling, it loſes its clearneſs, ſaline matter is ſeparated, which its former temperature retained diſſolved.

MXX.

By evaporation urine affords a thick, brown, fœtid maſs, compoſed of empyreumatic oil, ammonia, ſeveral gaſes, and a portion of phoſphorus; and by the retention of urine, in cloſe veſſels, a great quantity of ammonia is diſengaged. By the fixed alkalies a precipitate is thrown down, compoſed of phoſphate of lime. Gelatin is diſcovered by the infuſion of tannin; and by uſing various teſts the farther principles of the urine are found to conſiſt of phoſphate of ſoda, ammonia, lime, and magneſia, muriat of ſoda and ammonia, uric acid, and ſometimes benzoic acid.

MXXI.

The uric acid has been already conſidered; but the peculiar matter, or uree, remains ſtill to be noticed. In this matter, the colour, odour, and prinoipal properties of urine reſide. It is obtained pure by evaporating urine to the conſiſtence of honey, and adding alcohol for its ſolution. On evaporating the alcohol the reſiduum is diluted, with water, to the conſiſtence of a ſyrup, and nitric acid then added. A compound is then formed, ſoluble in water, to which potaſh being added and evaporation employed, on the addition of alcohol, diſſolves the uree, and gives it by another evaporation pure.

This matter then diſſolved in water, conveys to the fluid all the peculiar properties of urine, and it is ſuppoſed to conſtitute about $\frac{1}{20}$ part of this fluid. This matter is highly ſuſceptible of decompoſition, and by heat gives out ammonia and oil, in ſmall proportion.

MXXII.

Beſides theſe purpoſes of the urine and perſpiration, they ſeparate from the alimentary matter ſome parts which are redundant, or of ſuch a nature that they are incapable of being converted into good blood. When the urine is emitted not long after a meal, we perceive ſome degree of the flavour of the ſubſtances which were eaten, and it is plainly compoſed of the redundant water taken to facilitate the diſſolution of the food; and from its eaſy reception into the veſſels ſoon after it enters the maſs of blood, a great quantity of this is ſeparated by the ſecretion of the urine.

MXXIII.

The calculi found in the urine are formed from the lithic or uric acid, a peculiar concrete acid, which can be obtained from them by ſolution in an alkali or precipitation in an acid. All urine contains this ſaline ſubſtance, which in combination with albumen conſtitutes calculis, and a ſlight change of circumſtances occaſion its generation. We find this matter depoſited at the bottom of the glaſs, or other veſſel, in which urine is preſerved, though not forming ſo

hard a concretion as takes place fometimes in the bladder, and in feverifh diforders it concretes into fmall cryftals like thofe of falts; a cloud is formed which when held in the fun fparkles, and when examined with the microfcope, or magnifying glafs, appears like the cryftals of neutral falts, which have had that angular figure in confequence of a particular mode of cryftallization, or concretion, by which the parts of it are united together. What makes it thus concrete in thefe difeafes is uncertain, but in other cafes the circumftances are, the prefence or contact of fome folid matter in the urine. Experience has fhown that a folid body introduced on purpofe, or by accident, has given occafion to a calculus, where there was no previous difpofition. Thus a bit of leaden probe which had been introduced in confequence of fome venereal complaint, or a needle thruft into the bladder of a dog, have had a calculus formed upon them. In one cafe a fmall horfe bean was the nucleus; how it got there is not to be traced, but probably it had been thruft in fome how into the urethra; it was fo entire that there was not the leaft doubt of its nature. If it is difficult to conceive how the matter fo readily adheres to folid bodies, we fhould confider it fimilar to the cryftallization of falts, which depends upon the prefence of folid matter. There is always a collection of the faline particles to fuch bodies, as in the cryftallization of vitriol, after the liquor has been obtained from the pyrites, and is faturated with iron, the workmen put into it a number of fticks; they place wooden bars over the top, and hang down from thefe large forked fticks; and all the clufters are formed on the internal furface of the veffel, or on the furface of thefe fticks, which are covered to a great thicknefs, and the cryftallization of the urine feems to be brought on in like manner, by the contact of a folid body; though this is not an explication of the matter, yet it is a fimilar cafe, which always ferves, in fome meafure, as an explication of the matter: and in whatever manner a folid may come to be prefent, fomething of this kind is the caufe of all calculi. In calculous cafes we obferve generally a blackifh coloured bloody matter, or mucus, which

has loſt its uſual appearance, by putrefaction or length of time, in the urine; this might come from the papillæ uriniferæ, or mucous glands, in the pelvis of the kidneys, in conſequence of ſome ſlight inflammation, or catarrhous affection; juſt as blood comes from the lungs in pleuriſy, or peripneumony, or from the noſe in catarrh; and this may give occaſion to the concretion of calculus, without occaſioning pain, the kidney poſſeſſing but little ſenſibility.

MXXIV.

But after the calculus is formed, an affection may diſpoſe the kidneys to be more eaſily irritated; a ſlight catarrhal affection of the membranes may increaſe the ſenſibility to a morbid degree, and expoſe them to be irritated by the preſence of a ſmall calculus, and this is probably the cauſe of pain; where there is a ſmall calculus in the kidney, or bladder, a ſlight inflammation of theſe parts rendering them more irritable; at leaſt the hiſtory of Lithonthriptics ſupports this idea: theſe have been conſidered as diſſolvers of the ſtone, and their nature has been already treated, in the diviſion of ſalts.

MXXV.

Though the effect of putrefaction on the animal ſubſtances in general has been already treated, the putrefaction of urine deſerves a little more notice, as being in ſome meaſure different from that of other animal humours. Here there is no ſuch inſupportable fætor; there is no ſuch large proportion of inflammable matter as in the blood and other humours. It is chiefly a ſaline matter, and the effect of putrefaction is to ſeparate the volatile alkali combined with the other ſalts, ſo as to give a remarkable pungency to the urine; and in conſequence of this, it is often employed for cleaning of clothes, the volatile alkali having the ſame detergent quality as fixed, and for the extracting the acid from the ore of allum, which contains another proportion of acid, and no cryſtallization takes place till ſome alkali is added to attract a portion of that acid. The other changes produced are, that the viſcid or unctuous matters

are attenuated, fo that the falts are more eafily feparated. Thus the urine is purified, from which the falt of the phofphorus is obtained.

MXXVI.

The laft of the excrementitious fecretions is that performed upon the internal furface of the inteftines.

The matter thrown out in this way cannot be very precifely diftinguifhed, as it is mixed with fuch a quantity of the dregs of the alimentary matter, and it undergoes its degree of completion after it is fecreted in its paffage; but that a fecretion is performed, appears from the neceffity of this evacuation, independant of the quantity of food, as is well known to practitioners in the cafe of fevers and other difeafes, in which there is a want of appetite; yet it is neceffary to have the belly open to promote this evacuation, otherwife a quantity of matter is fure to accumulate, which is attended with feveral bad confequences; this fhows that this matter derives its fource partly from fome other quarter, befides the excrementitious matter of the food. But further, medicines which provoke the other two fecretions, provoke this alfo, as falts; which taken in a certain quantity, and diluted with a warm regimen, generally increafe the fecretion of the fkin; in larger quantity, with a cooler regimen, they generally provoke the fecretion of the urine; and if they are given in ftill greater quantity, they increafe the fecretion of the inteftines. But further, in particular difeafes, in which the fluids are conftantly degenerating into a particular ftate of corruption, as in phthifis, they are obferved to run off in this way; at firft the patients are diftreffed with fweating; but in the end of the difeafe the corruption of the humours goes on more rapidly, and great quantities of it are thrown out by the inteftines; the colliquative diarrhæa then comes on.

Thefe evacuations, therefore, feem to carry off the moft grofs and putrid parts of our corrupted fluids and folids, which, mixed with the bile and the remains of the food, make the fæculent matter.

MXXVII.

Experiments have been made upon this fæculent matter, on the ſuppoſition that an oil might be obtained from it, capable of changing mercury into gold; and an oil has been drawn which was ſo different from that matter, that it had rather an agreeable ſmell like that of muſk. This proceeded from the bilious part of the fæces probably, for the bile acquires a muſky odour during its putrifaction. The ſame odour is found in the neighbourhood of dunghils, and in this country it is common to uſe bile, or the dung of oxen or cows which live upon graſs, and have a large quantity of bile, in bleaching clothes, and it communicates a muſky ſmell to them. The analyſis, however, of the fæces ſhew that they conſiſt of water, carbonated hydrogen gas, a fœtid principle, the remains of undigeſted food, and a mixture of inteſtinal liquors.

From thoſe excrementitious ſecretions we come to the ſecond diviſion, that comprehends the uſeful ſecretions, which are prepared into proper liquors, and applied to uſeful purpoſes in the body. Theſe may be divided into ſix claſſes, or kinds.

1. The liquors are prepared to lubricate the ſolids, to diminiſh their friction upon one another, or other hard bodies.

2. The liquor, or liquors, prepared to defend different ſenſible parts from acrimony of different kinds to which they are expoſed.

3. The ſemen.

4. The nervous ſecretion, whatever it is, or the function performed by the brain.

5. The fluid employed by the digeſtion. And,

6. The milk, or nouriſhment, prepared for the young animal.

MXXVIII.

The firſt of theſe are of two kinds. Firſt, A ſerous, or albuminous liquor, for the purpoſe of lubrication. We have examples of it in the cells of the cellular membrane,

throughout the greateſt part of the body. Some cells are filled with fat, but theſe are particular cells, the intertexture of which is intermixed with the ſolids of the body, and binds together with ſome force, but is detractile, allowing them to move with freedom upon one another. This has every where a quantity of ſerous liquor interpoſed between its fibres; there are ſome of the fibres of this contexture which contain fat, but they are particular cells, and are ſaid to be even of a different ſhape. Further, we find this kind more eſpecially preſent in that more compacted membrane which ſurrounds the tendons of muſcles, and the muſcles themſelves, and it is called the ſheath of the tendons on many occaſions; and in certain receſſes of theſe ſheaths which are now called the burſæ mucoſæ, out of which this fluid iſſues more plentifully, a more plentiful ſecretion taking place here on account of the violent motion with which theſe parts are agitated by the muſcles, The ſame liquor is ſecreted in the ventricles of the brain. What purpoſe this, or even the ventricles themſelves, ſerve, is not eaſily explained. The brain has motions from the pulſation of the arteries, and alternate fillings of the veins during reſpiration; but the motion is ſo ſmall, that we cannot underſtand the meaning of this ſecretion here. Further, we find the ſame liquor in the pericardium, or between the ſurface of the heart and membranes which inveſt it, and over the whole ſurface of the pleura, and between that and the ſimilar membrane which covers the ſurface of the lungs, to facilitate the ſliding motion of the lungs on the ſurface of the pleura. We alſo find it in the cavity of the abdomen, interpoſed every where between the ſurface of the guts, where they are contiguous to one another or to the other viſcera, and between them and the peritoneum. In all theſe parts there is a very ſimple apparatus for the ſecretion, merely the extremities of ſmall arteries opening into theſe cavities without filling any glands, the ſtructure of which was in any degree remarkable. When this liquor is examined, it is ſaid to have the qualities of the ſerous part of the blood; it conſiſts chiefly of water, but it contains albumen, or a

ſubſtance wh·ch is coagulable by heat; acids, and the ſpirit of wine. Some times when it ſtagnates long, it acquires a greater degree of thickneſs and viſcidity, as in the ſheaths of the tendons and burſæ mucoſæ, and forms indolent tranſparent tumours, which become at laſt gellatinous.

MXXIX.

Very ſimilar to this ſeems to be the ſecretion performed in the joints; the liquor is not exactly the ſame, it has a greater degree of viſcidity, is rather more lubricating, and is prepared by the apparatus of a conſiderable gland lodged in the inſide of the joint, and ſo ſituated, that the moving of the joint expoſes the gland to a gentle agitation and compreſſion, which tends to increaſe the ſecretion when it is needed, or when the joint is moſt uſed. We are told by Haller, that this is much of the ſame nature as that found in the cavities; it is coagulable in like manner, ſo conſiſts chiefly of the ſerous, or albuminous part of the blood, viz. lymph with muriate and carbonate of ſoda.

MXXX.

The other remarkable ſecretion performed to afford a liquor to defend the ſolid parts from natural friction, is found every where upon the ſurface of the ſkin in the cellular membrane, in which it is liable to accumulate in very large quantity, and alſo in the cavity of the bones. On the ſurface of the ſkin it ſerves to prevent the different parts from being hurt by rubbing on one another, and to prevent the ſkin from the irritating effects of the air. The cuticle has been conſidered as a curious part of the body; one uſe of it is to preſerve the ſkin from the drying effects of the air; for when it is removed in the dead body there is a quick evaporation of the fluids, and the ſkin drys into a horny maſs, while the other parts continue in their ſoft and plump ſtate, and the cuticle is aſſiſted by this fatty and ſebaceous matter ſecreted on the ſurface, where there is always a certain quantity prepared for particular glands, or follicles into which the liquor is poured, and by ſome ſtagnation it acquires the qualities of an oily or ſebaceous

matter. That in the cellular membrane may alſo anſwer other purpoſes, as much as the purpoſe of lubricating; at leaſt, where it is ſecreted in large quantity, there it is depoſited as a ſuperfluous part of the aliment, which cannot be conſumed in the performance of the animal functions, ſo it is depoſited there, ſtored up to afford nouriſhment to the body in caſes of need. This would appear from the effect of long diſeaſes which are attended with great emaciation, and there is a great conſumption of this fluid, which is quickly abſorbed. That it has a great power in nouriſhing appears from experiments, as it has been found that fatty ſubſtances have more effect in nouriſhing than any other matter. This unctuous matter ſecreted upon the ſurface of the ſkin is in ſome animals attended with an odour, as muſk, civet, and which ſeems to be of this kind. The chemical analyſis of this matter ſhews it the ſame with fixed oil, as already deſcribed in p. 139.

MXXXI.

The ſecond kind of ſecretion, to prepare a liquor to defend different parts from acrimony, is the ſecretion of mucus, the nature of which anſwers very well for this purpoſe. It is a viſcid ſubſtance, conſiderably more viſcid than the albuminous part of the ſerum; it is coagulable by heat in like manner, but it is not near ſo diſpoſed to putrefaction; there is no fluid of the animal body which has leſs diſpoſition to it. We have an example in ſome parts, where it is neceſſary that it ſhould reſiſt putrefaction; thus it is prepared upon the internal ſurface of the membranes of the noſe and fauces, through the whole of the tract of the aſpera arteria, and the whole length of the alimentary canal, and moſt copiouſly in the rectum. It is alſo prepared through the whole of the paſſages through which the urine paſſes. The noſe is expoſed to the irritating action of the air and acrid effluvia, which that organ gives the perception of; ſo this ſecretion is neceſſary for its defence; and it was neceſſary that the viſcid matter ſhould not be liable to corruption from being expoſed to the air, which ſo much corrupts the animal ſubſtances in

general. In like manner, it is expofed in the lungs; and it is neceffary, therefore, for the fame reafon, as in the fchneiderian membrane, as alfo in the fauces. Its neceffity is obvious through the whole of the alimentary canal, on account of the acrimony and corruption of the aliment, and particularly in the rectum, where the matter has acquired the greateft degree of acrimony. The fecretion is performed there by numerous glands, or follicles which are found in the inteftine; the neceffity of it is as obvious in the urinary paffages, particularly in the bladder, and moft of all in the urethra. The nature of the glands by which this fecretion is performed is much the fame; they are little bags which communicate to the furface of the cavity; they have numerous veffels entering into their cavity which depofit here the fluid, from which the mucus, or infpiffated lymph, is to be produced. This ftagnates for fome time in the follicle, fuffers an abforption, and acquires the proper degree of vifcidity which fits it to anfwer its purpofe. It is impoffible that this fhould be fecreted as vifcid as it is when it is applied to the furface; it is intended to protect from acrimony: fo vifcid a liquor could not circulate; it iffues out from the minute veffels under a very great degree of fluidity, but ftagnating afterwards in the cavity, the moft fluid parts are abforbed, and the remaining matter acquires the proper degree of vifcidity. This general remark too may be made, that a ftimulus applied to the furface, or cavity for which the mucus is deftined, has the effect of increafing the fecretion of the glands which prepares it. As to the fchneiderian membrane, it produces an increafed fecretion of the mucus, and fo of the other parts of the body in which it is performed: whenever the acrimony is increafed, the fecretion of this fubftance, in order to obviate it, is alfo increafed; the nature of it too is altered in confequence of difeafes, and the corrupted fluids are thrown out in great quantity; fo in the phthifis, or even a common catarrh, a quantity of purulent matter is fometimes thrown out in this way. There are many particular patients who throw out pus, or matter not to be diftin-

guished from it, and yet, when opened, the lungs are quite free from any ulceration; so the whole must have been secreted by the mucus glands of the lungs, and the discharge changed in its natural appearance by the absorption of oxygen. That this is possible, we have examples in common colds, particularly in the coryza; it begins with an irritation and slight inflammation in the membrane lining the nose, attended with an increased secretion of the mucous matter; after some time that inflammatory disposition is resolved in consequence of a secretion of thick purulent matter by these glands; it has all the appearance of purulent matter, as inflammations terminate in inflammatory exudations, or a secretion of purulent matter. Thus a purulent matter may be excreted by these glands, and prove a sort of crisis to the disorder.

MXXXII.

With regard to the semen, nothing on its secretion is to be said, as the qualities of it are such as chemistry can give us no assistance in, nothing being detected in it but water, animal mucilage, and various neutral salts, as phosphate and muriat of soda, pure soda, and phosphate of lime.

4. With regard to the secretion formed in the brain, we have no conception of the fluid which is prepared there.

5. The fluids employed in the digestion of the food are chiefly the saliva in the mouth, the gastric liquor in the stomach, and the bile and pancreatic juice added after the food has passed out of the stomach.

MXXXIII.

The saliva consists almost entirely of water, with a small quantity of albumen dissolved in it, with muriat of soda and phosphate of lime. When evaporated, the dry matter yields the same principles as the animal substances in general. It is found, that added to mixtures of alimentary substances, it moderates the fermentation these mixtures were disposed to run into. Thus dressed meat taken in different proportions, nearest to those in which they are

commonly uſed for food, run into a ſtate of fermentation and are diſſolved, but the ſaliva moderates this and prevents it from diverging ſo ſoon, either to the putrid or aſceſſent ſtate. This, therefore, is one uſe of the ſaliva, though by no means the principal uſe of it. Sometimes it is attended with a diſpoſition to form calculi in like manner as the urine: the hard ſtrong ſtony matter, ſo liable to collect on the roots of the teeth, evidently proceeds from the ſaliva; and concretions of the ſame nature have been found in the ſalivary ducts.

MXXXIV.

Of the gaſtric liquor we know ſtill leſs: it is difficult to get it pure; and though it was in our power, probably we would not find it very remarkable for its obvious qualities. From experiments, however, it would appear, that digeſtion in the human depends entirely in this gland, which has a ſlightly ſaline taſte, and is ſoluble in water. It poſſeſſes neither an acid nor alkaline nature, and when mixed with an acid, it is only in conſequence of ſome morbid affection. It is not coagulated by acids or alkalies, and is but ſlightly ſo by alcohol. Its chief property is its ſolvent power over animal food. This is moſt remarkably ſhewn in the ſtomachs of carniverous animals, much leſs in the graminiverous, and in a middle degre by that of man.

When ſubjected to chemical analyſis it yields water, animal gelutin, and phoſphate; when expoſed to heat it gives out water, and when evaporated leaves a dry maſs, affording ammonia, empyreumatic oil, and the reſidue contains carbon, muriat of ſoda, and neutral ſalts.

MXXXV.

This ſolvent power of the gaſtric fluid ſeems alſo confined to dead ſubſtances, and that it cannot act upon the living ones. The proofs of this are clear from appearances which occur in the opening of bodies ſoon after death, when we find the ſtomach totally diſſolved; as in the opening of perſons who have died a violent death; and the ſame thing occurs in the examination of other animals,

as in the fishes which are killed suddenly, and in the best health. It has happened, that in some dissections the stomach has been found perforated, and the death of the person has been imputed to this circumstance; but from the facts collected, it would appear that this may occur without having any connection with the disease or death of the person; and from examples, in which the disease was quite plain, all the circumstances concurred in showing its nature, for there was not the smallest complaint about the stomach; and yet immediately after death, as soon as the body cooled, the stomach was found dissolved into a mucilaginous matter, which must have been by the action of this liquor. As soon as the stomach is dead, it immediately begins to exert its power to dissolve it, to extend that power which it has over all dead substances in acting upon them as a solvent; and at length, after it has perforated the stomach, upon coming in contact with the other viscera, it will act upon them, and dissolve more or less of them.

MXXXVI.

The pancreatic fluid is supposed to be similar to the saliva, in consequence of some experiments, by which it was contrived to act upon the duct and insert it in a phial. Upon examination, it was found to have qualities similar to those of the saliva.

MXXXVII.

But the bile is considerably different, and possesses curious qualities, but is still imperfectly known. It was commonly supposed to be highly putrescent, or that it contained an acrimony in its composition, of an alkaline nature, for correcting the acid tendency of our food, and it was supposed saponaceous for keeping the union of the oily fluids with the rest; but any experiments which have been made upon it have contradicted this notion. It is not so highly putrescent as the blood and other animal fluids, neither is it saponaceous; upon being agitated with oil and water it does not dispose the oil to unite with the water.

MXXXVIII.

To the taſte the bile is bitter, and poſſeſſes a yellowiſh green colour; it is decompoſed by acids, which ˈare always a green colour; but its principles are beſt reſolved by coagulating it with alcohol. If the coagulant is ſeparated from the green liquor in which it floats, a taſteleſs viſcid ſubſtance reſembling albumen is procured, while the liquor filtrated retains the colour and taſte of the bile: if again the alcohol is evaporated a concrete matter is obtained, poſſeſſing the properties of a reſin, and therefore named the reſin of the bile. It is generally ſeparated by acids, in the form of a white unctuous concrete by the oxygenated muriatic acid; to theſe principles of the bile ſoda may be added, joined with carbonic acid.

This green colour of the bile from acids, explains the green purging in children, when their ſyſtem is diſturbed by teething and other circumſtances. They often, after the firſt ſymptom of diſturbed digeſtion, are ſeized with purging, and paſs conſiderable quantities of green matter, which is bile altered into this colour by the preſence of an acid.

MXXXIX.

Biliary concretions are totally different from the concretions formed in the paſſages of the urine and ſaliva; they are called gall ſtones, but they are not ſtones; there is no earthy or ſtony matter in them; they are always inflammable, conſiſting of a ſebaceous matter, which has a more ſolid conſiſtence than the general run of the animal oils, and a ſolidity reſembling ſpermaceti, which is a dry animal fat. It can be eaſily reduced to a powder, melted with heat, and concreted in like manner. The parts arrange in a number of plates, which are collected into aſſemblages and cryſtallizations, as in ſpermaceti. From this will be found how vain it is to attempt to diſſolve theſe by ſuch medicines as have been uſed for that purpoſe, which are ſuch as have been commonly ſuppoſed efficacious in diſſolving the ſtone in the bladder, as lime water and ſoap; but when

these substances are applied to gall stones, they produce no effect whatever. There is generally a remarkable crystallization from the centre towards the surface in the structure of these biliary concretions: when they are cut with a knife through the centre, we see radiated crystallizations, and often there are several orders of these. There is a nucleus of a dark coloured matter, round this there is a mass of crystallized stuff; then, perhaps, a thin layer of brown coagulated matter, and upon that a thick crust composed of a pure sebaceous matter, and these crystallizations always stand perpendicular to the internal surface of the stone. Neither soap nor lime water, nor alkaline lees, produce any effect upon these concretions; neither do they act upon spermaceti. They are employed in the refinement of this substance to extract the small remains of the liquid oil, and the alkaline lees unite with the oil and refuse to unite with the spermaceti.

MXL.

Experiments have been made upon this subject, and a solvent of these concretions has been found in a mixture of spirit of wine and oil of turpentine. Neither of these acted upon the concretion completely, when used separately; the one divided the calculus into separable crystallizations, the other has very little action upon it; but mixed together they produce a quick dissolution and separation of its parts; so it has been proposed to be used as a solvent of these concretions, and a formula is given, which it is imagined has proved useful; but it is difficult to conceive how it can reach these concretions so as to affect them. At the same time that some of these alkaline substances will not dissolve the biliary concretions, they often do service in cases of jaundice, and some practitioners lay great stress upon large doses of soap. But they cannot possibly give relief by dissolving the concretions, for they cannot reach the biliary ducts in such a short time as is found to be necessary for obtaining relief. Their power, however, may be in consequence of the stimulus with which these medicines affect the duode-

num. In general, throughout the body, wherever a liquor is ſecreted, if that part of the body be irritated, the ſecretion is increaſed, there is ſome connection of ſenſibility between that part and the organ of ſecretion, by which the ſecretion is greatly increaſed; as when the eye is irritated there is a greater ſecretion of tears; if the noſe is irritated, there is a greater ſecretion from the mucous glands there. Now jaundice may ariſe from a collection of viſcid matter, inſpiſſated mucus, &c. ſtopping up the paſſages of the bile, &c. and a ſmart ſtimulus applied may be effectual in procuring an increaſed ſecretion of the bile, which will open the paſſages. Or the jaundice may ariſe from a ſpaſm, which is ſometimes removed too by a ſtimulus to a neighbouring part. Theſe concretions, when analiſed along with the reſin of the bile, contain benzoic acid and ſmall portions of lime, ſoda, and ammoniacal ſalts. Upon the whole, it is plain that the ſubject of the bile is ſtill open for much enquiry.

MXLI.

The milk now only remains, which is compoſed of water, holding diſſolved in it a ſaline matter, approaching in its nature to ſugar, a very bland oil, and a coagulable part of the ſame nature with the coagulable part of the ſerum. This is the medium for mixing the oil with the watery part into an emulſion, and by mixing ſimilar ingredients artificially together, a very exact imitation of it can be made. It is from that coagulable matter or gluten that it derives its diſpoſition to be coagulated by acids and heat. If it is boiled, a pellicle of coagulated matter forms at its ſurface, which if taken off is renewed again, and this will not diſſolve in water. The ſerum being coagulated partly by the heat and partly by the action of the air, which produces the coagulation of the lymph, it is therefore from that principle that the milk derives its diſpoſition to coagulate from the ſaline or ſaccharine matter. It is diſpoſed to aceſency in ſome kinds; it approaches nearer to ſugar than in the common milk, and can be made to undergo the vinous fermenta-

tion, and it produces an inebriating liquor, as the milk of asses, mares, &c.

These principles are soon unfolded when it is allowed to stand at rest for some time. The oily part, or cream, collects on its surface; and the solid part, when it is removed and agitated for some time, becomes a concrete oil or butter, similar in its nature to the animal fat, (as detailed in p. 138.) After the separation of the cream the milk becomes ascesent, and then coagulates. When the fluid is parted from the coagulum a matter is obtained similar to animal gluten, termed cheese or coagulum, as already noticed.*

The fluid, or serum of the milk, now only remains: having acquired an acidity from stagnation, and when evaporated, it affords a saline substance, or the sugar of milk. From this sugar of milk two peculiar acids are obtained, already noticed in p. 185.

In the serum, besides the sugar some neutral salts are also detected, muriate and phosphate of lime, muriate of potash and soda.

MXLII.

The yolk of the egg, as it serves a similar purpose to that for which the milk is intended, is much of the same nature, and has a communication with the stomach of the chicken within the bag in which it is lodged, and supplies the animal with nourishment after it is hatched, and by being diluted with water forms a fluid not unlike the milk, and can be substituted to it on many occasions; and as it contains less of a saccharine matter, it is rather safer for weak stomachs than milk is, and it is recommended in place of milk for this purpose, merely diluted with water in its raw state, and a small quantity of sugar added, to render it more agreeable. From the large quantity of coagulable matter the yolk can be employed to promote the union of more oil than what it contains with water. The oil in it, however, abounds so much, that when the coagulable matter is fixed, concreted, and the yolk dried with a gentle heat, a considerable quantity of oil is obtained by expression.

MXLIII.

To complete the hiſtory of the animal fluids, it may be thought neceſſary to mention certain changes to which ſome of theſe are ſubject, which are the cauſe or conſequence of contagious diſeaſes. Barely mentioning the facts is all we can do. They depend upon cauſes which are not within the reach even of our imagination. The hiſtory of contagion ſhows that nations may preſerve themſelves from ſome deſtructive diſeaſes, by keeping out of their way, and the object of their attention is a particular ſpecies of matter which muſt be kept out with care. If it reaches any one it throws the ſyſtem into a tumult, proves fatal perhaps, and proves a ſource from which others around are infected, from whom again it may be propagated to millions of others; but it is ſomething too ſubtle to be perceived by the ſenſes. It is ſometimes lodged in a bit of rag, and is only evident by the pernicious effects which it produces upon thoſe who are ſo unfortunate as only to touch. We have a familiar example of it in the ſmall-pox; the moſt minute atom of the infection is ſufficient to communicate the diſeaſe to one, and through him to millions of others; but the active part is not perhaps the thouſandth part of its weight: we do not know how little may ſuffice to produce the diſeaſe. Theſe facts are not explicable upon any principle of which we have at preſent any knowledge.

The chemiſts give an illuſtration of it from the parallel example of fermentation. We cannot bring the farinaceous matter into the vinous fermentation, not even though malted, without the aſſiſtance of a ferment; but once this is applied it produces a much greater quantity of ferment; and a ſmall quantity of this liquor added to a much greater quantity, will bring it all into the ſame ſtate, and every part will anſwer the ſame purpoſe; but this ſimilarity does not amount to an explication; we do not underſtand fermentation itſelf, ſo as to admit of its giving light to the other ſubjects.

MXLIV.

Functions of the Body.

From this view of the constituent principles of the animal body, its functions come naturally into review.

MXLV.

Digestion.

5. Food is required for the supply of these principles of the animal body detailed; it is introduced for this purpose by the mouth, and in man it is reduced there to a pulpy consistence by the teeth and its mixture with the saliva. In this state it is removed into the stomach, where new changes on it ensue. This organ differs in its shape in different animals. In man it has been compared to the bag of a bag-pipe, and here the food is converted into a soft pap, differing from the food as first introduced, and receiving the appellation of chyme.

MXLVI.

6. This chyme, when examined, possesses new properties. New combinations of its principles must have therefore now taken place to acquire them, and the means by which these combinations have been effected we must look for in the organ into which the food has been introduced.

In doing so, we find it to depend on the action of the gastric fluid, or secretion of the stomach, which in man appears to operate equally on animal and vegetable food, which unites internally with it, and cannot be separated by filtration, and which acts rapidly in proportion to the minute division of the food and the degree of temperature. Two circumstances alone we can trace peculiar to this fluid; its holding a portion of uncombined phosphoric acid, and its possessing the power of coagulating milk. A certain quantity of the saliva seems also a necessary assistant to this fluid.

MXLVII.

The chyme passes from the stomach into the intestines. Here it is subjected to new changes, and the effect of

these changes is to convert it partly into chyle and partly into excrement.

MXLVIII.

Chyle is a white liquid, resembling milk, and is apparently milk in a less perfect state than when excluded from the breast. It possesses albumen, serum, and globules, like cream, with different salts, and something like the sugar of milk. Even a proportion of iron has been suspected in the form of a white oxyd.

MXLIX.

The process of chylification is unknown. The product is clearly separated, by a chemical change, from the chyme, and the consequence of this separation is the division of the chyme into this liquor and into an excrementitious part, which two parts continue afterwards always inseparable, and incapable of decomposing each other. What share the bile has in this separation is uncertain; but it seems necessary, to evolve completely the excrement, to prevent its absorption, and facilitate its discharge from the body. The excrement then, as well as the chyle, is a new compound, consisting of undigested food, decomposed however in its passage through the stomach and bowels, and combined with the bile and other fluids previous to its exit. Hence in the dung of graminivorous animals is found a new product, or benzoic acid.

ML.

During this process of chylification an evolution of different gases takes place, both in the stomach and bowels. In the former is found carbonic acid, oxygen, hydrogen, and azotic gases. The same is found in the intestines; but the two former prevail most in the stomach, and gradually lessen in the intestines, while the two latter increase in that situation the flatus for anum, consisting of carbonated hydrogen gas.

MLI.

The chyle thus prepared is absorbed by the lacteals, and carried through them into a large reservoir, termed

the thoracic duct. In this reservoir it is mixed with another liquor, transmitted from the different surfaces and cavities of the body to the same place, named the lymph.

MLII.

The nature of the lymph is equally uncertain with that of the chyle. It is a fluid colourless and somewhat viscid, containing albumen, and probably gelatin. But its union with the chyle, we have reason to suppose, a farther step towards the perfection or animalization of the former, and blended together they are conveyed directly into the blood-vessels, and in man to their very centre, or the heart. But in this organ they are not allowed to remain, they are immediately conveyed from it into the lungs, to undergo farther alterations.

MLIII.

Respiration.

The alterations next that are necessary to be made by the lungs are the perfection of their still incomplete animalization, by the extrication of the remains of the constituent vegetable principles in their composition, and the introduction of a greater quantity of another principle not sufficiently received from the substances taken into the stomach.

The first of these is the separation from the blood of carbonic acid and hydrogen, the two chief constituent principles of vegetables; and the second, immediately on its presentation to this fluid in the lungs, is the absorption of oxygen or vital air, necessary both to effect this separation, and also to be introduced as essential to the support of the principle of life, of heat, and the regeneration of the solid parts of the system.

These changes are conspicuous by the disappearance of the chyle; 2dly, by the change of the blood itself to a florid red colour, which is clearly the effect of the absorption of oxygen; 3dly, by the blood being incapable of stimulating the heat, without it receives this change; 4thly, by the temperature of all animals being in pro-

portion to their degrees of refpiration; and 5thly, by the febrine, or rudiments of the folid, never exifting either in the chyle or lymph till mixed with the blood, and acted upon by the procefs of refpiration.

MLIV.

Thus by digeftion and refpiration the functions of animalization take place. But the changes induced on the blood by refpiration are not fufficient for the continuance of life. Farther alterations are required, and one of the chief of thefe is the feparation of certain of its parts by the kidneys.

MLV.

Through this organ there paffes at leaft 15lbs. of blood in the fpace of each hour; and as death is foon the effect of any difeafe of this organ, its function is effential to exiftence, and from its fluid, or the urine being difcharged, it is its feparation from the blood that is the fole purpofe of its ufe. The parts of the blood thus feparated appear to be water and faline mater, but this faline matter produces, by the action of the kidneys, a new product, uree and uric acid, the principles of which muft have previoufly exifted in the blood, and required therefore to be feparated.

MLVI.

But befides thefe different changes already noticed, a fomething farther feems to be expelled from the blood in the general courfe of its circulation, by means of the fmall veffels fituated near the furface or fkin, termed the perfpiration. This fomething feems to confift of the fame matter that is difcharged by the lungs. The quantity varies at different times and under various circumftances.

MLVII.

Thus if we trace the different fteps of the progrefs of animalization till complete, we find that the firft ftage confifts in the formation of chyle; that the fecond depends on the mixture of the latter with the lymph; that the third ftage is the union of thefe two fluids with the

venous blood on entering the heart; that the fourth ſtage diſplays the oxydation of the lungs, or abſtraction of the ſtill unaſſimilated parts; that the fifth effects, by means of the kidneys, the ſeparation of thoſe principles, which if accumulated would produce an exceſs of azote, or endanger a premature deſtruction of the ſyſtem.

Thus the blood, perfected by theſe different changes, is fitted to repair the waſte, and to continue the ſupply required. It is the ſtorehouſe from which materials are provided for all its wants. It gives for the bones phoſphate of lime and gelatin; for the ſoft parts febrine and albumen; and by the proceſs of aſſimilation theſe materials are formed according to the particular and neceſſary arrangement. Over this proceſs, however, of aſſimilation the veil of darkneſs hangs. No facts can yet explain it.

The only circumſtances with which we find it attended are:

1. That every aſſimilating organ performs its own peculiar office, whenever materials are preſented to it for this purpoſe.

2. If theſe materials agree with the natural ſecretion of the organ, they paſs into it unchanged. Thus milk is abſorbed unchanged by the lacteals.

3. Aſſimilating organs do not produce any change on matter preſented to them of a ſimilar nature with their own. Thus blood can be transfuſed without any change taking place. Muſcular fleſh can be alſo incorporated; while foreign ſubſtances produce, on the contrary, the death of the part.

MLVIII.

Thus aſſimilation is a chemical proceſs under the influence of the action of the animal organs, and ſubjected to a ſuperior agent that acts by fixed and determined laws. This agent, or the animal principle, is evidently connected with the ſtate of the brain, but itſelf is not matter.

MLIX.

Secretion.

But another ſpecies of aſſimilation not yet examined is ſecretion, by which the different liquors are ſeparated for the purpoſes of the œconomy. Though this proceſs is equally unknown, we find, in order to its taking place, that the blood paſſes through veſſels of different diameters, often contracting to a very ſenſible degree, and carried through a very extended courſe. But by this mode of conveyance ſucceſſive decompoſitions muſt take place, producing a variety in the nature of the different products.

MLX.

Deorganiſation.

By the exerciſe of the functions for a certain time, their powers become impaired, the body decays, and death enſues; and in this caſe the powers of digeſtion and aſſimilation firſt fail, where death does not happen from extraneous cauſes. The extinction of life occaſions a decompoſition of the animal body. The chemical and mechanical agents, forming its principal ſupport, are now the means of its deſtruction, and the ſpontaneous changes which it undergoes, from the re-action of its elements, vary according to the circumſtances under which it is placed. Thus if excluded from air and moiſture, it ſlowly decays till nothing remains but an apparent earthy matter.

If of a firm fibrous texture, and immerſed in water, the ſoluble part of the animal ſubſtance is removed, and the reſt converted into a fat ſubſtance, reſembling ſpermaceti, the azote and phoſphorus being diſengaged, along with the hydrogen, and the remains of the latter, with ſome oxygen, uniting with the carbon to form fat.

When air is admitted, the proceſs of putrefaction, (if aſſiſted by a certain heat and moiſture,) enſues, by which the parts entering into new combinations, paſs off in the form of gas, and leave an earthy reſiduum behind. The chief of the gaſes are ammonia, phoſphorated hydrogen,

ſulphurated hydrogen, carbonated hydrogen, and carbonic acid, and, perhaps, ſome other more compound gaſes may be alſo diſcharged.

MLXI.

From the products then emitted by this proceſs of putrefaction at the ſurface of the earth, changes are induced by the reception of theſe principles in the air, water, and ſoil. Theſe changes tend to the ſupport and nouriſhment of the vegetable kingdom, and thus the diſſolution of the animal body only takes place, in order that it may be again revived, by paſſing firſt into the vegetable body, before reſuming its original animal form.

MLXII.

Tables of Attraction.

Having now finiſhed a general view of the various bodies that form the objects of chemiſtry, and traced the principal changes that they induce on each other in conſequence of the relations their attractions bear; to facilitate the knowledge of theſe changes, various attempts have been made by chemiſts to form tables in which theſe various relations, or elective attractions, at once appear, both of the ſingle and double kind, for a view of which a reference may be made to the larger ſyſtems of chemiſtry.

PART II.

PHARMACY.

MLXIII.

HAVING now examined the various bodies of Chemiſtry, or the general principles of their action, we come next to purſue its application as directed to the purpoſes of Medicine, under the head of PHARMACY.

This is chiefly a chemical art, and conſiſts in the collecting, preſerving and preparing, for the uſe of the Phyſician, the various ſubſtances employed to act upon the human body, with a view to the preſervation and reſtoration of health.

The firſt object, therefore, is to collect the various articles in the ſtate of the greateſt perfection; and this requires a knowledge of their appearance and qualities in that ſtate, and to be able to diſtinguiſh them from one another.

To this it is difficult to give general rules. Such have been attempted, but theſe reſpect only the choice of vegetables, which having one general nature, are ſubject to general rules. The others are ſo different in their natures, that no rules can be given, except the taking each in its greateſt perfection, and a knowledge of the materia medica and of chemiſtry will be the only aſſiſtance.

MLXIV.

The general rules applied to vegetables may be reduced to the following heads:

1. That each plant be taken from ſuch ſoil, climate, &c. as are beſt adapted to produce it in perfection; for a difference in ſoil, &c. produces a wide difference in the ſame plant. It is difficult to believe what a variety of plants grow in every ſoil, as many of them are greatly diminiſhed by circumſtances which are unfavourable for their perfection, and even render them more inviſible; ſo with regard to the white clover and other plants which appear ſo ſuddenly when the ſoil is improved by proper manures, that it is generally thought ſtrange how they came there, but they were there before, only in ſuch a diminutive and ſhort ſtate that they were not viſible; ſo the difference of ſoil is of great conſequence to the perfection of plants. But this rule is ſo general, that it rather deſerves the name of a caution; and it is impoſſible to be more particular, as the variety of circumſtances and ſoils neceſſary to the perfection of different plants is ſo great.

It may be given as a general rule, that vegetables cultivated for pharmacy ſhould not grow too near one another, or be crowded with other plants, this making a great difference in their ſize and perfection. Every plant requires a certain extent of ſoil, through which it is to ſeek its nouriſhment, and if there is a greater number together, they meet with a ſmaller quantity of nouriſhment; and nothing is more certain from experience, than that plants too cloſe to one another never thrive ſo well as when they are put at a proper diſtance; ſo a principal part of the huſbandman's art depends upon his preventing all other vegetables from growing in the ſame ſoil.

It is thought to be a proper general rule with regard to the aromatic plants, to take them from dry ſoils and warm ſituations, which give them a greater richneſs in the quantity of aromatic oil they contain; and it is obſerved, with regard to roots, that their ſoil ought to be deep and open, for they will ſpread and expand more in proportion to its being ſuch.

Upon the whole, many of theſe directions enter too particularly into the ſubject, and require that the druggiſt ſhould become ſkilful in gardening and huſbandry. It is

sufficient for them to judge from the size and apparent vigour, and he should direct his attention chiefly to this point; he should learn to judge from the appearance and size of the plants he has occasion to see, whether they have been improperly cultivated, and have grown in circumstances favourable to their production.

A second rule generally given is, that they should be taken up at the time of vegetation, when they are most replete with medical efficacy; and this is different with respect to the different parts of the plants, and their duration in the ground. Plants are well known to exist a longer or shorter time in the ground, many coming up and dying every year, others arriving at perfection only the second year, rising to a certain size only the first year, shooting out their stalks and producing their flowers and seeds only the second year. In others the root continues in the ground for a number of years and seasons, producing a flower and stalk every year. The first of these are called annuals; the second, biennials; and the third, perennials. Now there are particular rules for collecting these, according to the nature of the plant. The root of annual plants is in the greatest perfection at a certain time of the season, immediately at a certain time before it begins to shoot out its stalks and produce its flowers, when the leaves are in their greatest vigour, and the plant is preparing to send up its stalk; by this time the root is come to the greatest strength, size, and perfection, and after this it is spent in the stalk; and by putrefaction after this, many of the roots become hollow: the roots of the biennials are to be taken up about the same time of the second year; or sometimes some of these are taken up in autumn, as is generally the case with regard to the perennials. There are many of these which, when they have produced the stalks, flower and seed, all these parts wither and die down to the ground, and the root sends up fresh leaves, and during this time acquires a considerable increase to its thickness and perfection; whereas waiting till the spring, some part of it is wasted in the production of new leaves: so the autumn is the best

time for the choice of these roots: but these rules will not apply universally. The time of flowering of the different plants is so very various, as also the time of forming their stalks, that no general rule can be given, except when the root is at the greatest perfection, and before its strength is wasted in producing its flowers and seeds. Many of the roots do not admit of being taken up at a particular season, but at any time lose their virtue if kept out of the ground; so they must be allowed to remain all the year, and must be taken up occasionally.

MLXV.

For taking up the herbs and leaves the rule is, to do it before the expansion of their flowers; but with regard to the hemlock, the leaves are in the greatest perfection about the time that the flowers are blowing, and now they are commonly gathered at this time. The leaves of some plants, as the marsh-mallow, containing a mucilaginous matter, which is the principal thing it is valued for, yield their matter to water best when they are taken young, as when they are allowed to grow to their full strength and size, a considerable quantity of them is converted into a woody matter.

With regard to flowers; they are best gathered when they are moderately expanded in a dry warm day; as when they are fully expanded they lose part of their subtle and aromatic matter, upon which their virtue chiefly depends, and it is more liable to be wasted in damp weather than in dry, the damp air being a greater solvent of it.

With regard to the seeds, the general rule is to take them when ripe and beginning to grow dry.

The fruits must be taken when they are ripe, unless it is ordered otherways; as in the seed of the cicuta, which is rather more efficacious than the other parts. The practice with regard to it, is to prepare an extract by boiling it with water, and it is necessary to collect it before it comes to its full maturity.

The woods and barks are in their greatest perfection in winter; but experience shows, that the best season for se-

parating the bark from vegetables is the ſpring, when the ſap is riſing in them.

MLXVI.

Another matter is exudation, or concreted juices, which flow out of the wounds made for that purpoſe, or from ruptured veſſels which have burſt from an overcharge of fluids: theſe flowing ſlowly, are inſpiſſated by evaporation to a ſolid maſs, ſo are prepared by nature, and reduced to a ſtate fit for preſervation; and it is not neceſſary to attempt any rules with regard to them, except that general one to the druggiſts, to make themſelves well acquainted with the appearances of theſe ſubſtances in their greateſt perfection.

The chooſing and collecting of vegetables being underſtood, the next object is to preſerve theſe ſubſtances. With regard to many of the objects of pharmacy, this is eaſy; as the ſalts, earths, inflammable ſubſtances and metals, ſome are volatile, deliquieſcent or fluid, and require different veſſels for containing them, which are well known, but they are not liable to ſuch a change as the vegetable and animal ſubſtances, from their fermentation and putrefaction; ſo this part employed in the preſervation of ſimples chiefly relates to vegetables, and the few animal ſubſtances which are uſed in medicine, as being thoſe which require the moſt troubleſome attention.

MLXVII.

The preſervation of vegetables is affected by having recourſe to the ſeveral means known to ſtop the ſeveral kinds of corruption, and the avoiding every thing favourable to it.

In general, the means employed may be reckoned, 1. The diſſipation of their humidity, and afterwards preſerving them dry. This is the moſt general means employed; and as a very great number of vegetables are preſerved in this way, it is thought an operation worthy of attention. Sometime ago it was directed, that the plant ſhould be dried in the ſhade; but more attention has

ſhown that this is quite wrong; and in order to preſerve the virtues of plants, we ſhould dry them haſtily. The heat of the ſun is the moſt eligible, perhaps; and if they were ſpread out upon a board painted black, they would be dried properly, as the board receiving the heat would produce a diſſipation of their humidity; but, in general, they are ſpread before a fire, at ſuch a diſtance as not to be ſcorched; and if this be avoided, the more quickly they are dried the better, as they retain their volatile principles in much greater quantity, for the humid air is a powerful ſolvent of the aromatic parts; ſo hemlock dried in this manner is preferable to any other preparation of it; and ſuch plants ſhould be immediately bruiſed and corked up in glaſs veſſels from the air, as they contain a ſaline matter and mucilaginous ſubſtance, which has a conſiderable attraction for humidity, enough to diſpoſe them to undergo gradually ſome degree of corruption. We cannot have a better illuſtration of this than in the curation of tea, which has been a manufacture long eſtabliſhed in ſome parts of the world. The leaves of this plant are dried haſtily in ſtoves, which are covered with plates of metal, and the leaves are frequently ſtirred, in order to make them curl up cloſe, ſo that they may not be broken in packing and unpacking; but the principal part is the drying the leaves very quickly. As ſoon as this is finiſhed, they are immediately put in metallic veſſels and preſerved ever after, and theſe are as cloſely ſhut up from the air as poſſible.

A ſecond mean is the covering them up from the air. Such plants as would be the worſe for loſing their moiſture we bury under a quantity of ſand, or cover them up in cellars, in order to keep them from the air and any great alteration of heat.

A third point to be attended to is, to keep off inſects, which prove very deſtructive to animal and vegetable ſubſtances. The manner of deſtroying ſuch inſects is chiefly by ventilating ſuch ſubſtances. Du Hamel obſerves that this is the principal method of expelling inſects from grain,

by running it down from one ſtory into another, while a ſtream of air is made to flow through a ſtream of grain. It is alſo neceſſary ſome times to apply heat greater than they can bear. Some of the dried roots are ſome times preſſed upon others; though the inſects attack them they are not the worſe; as in jalap, of which they eat the woody part, and not the reſinous, whereby it proves ſtronger; leſs ſerving for a doſe.

MLXVIII.

Vegetables may alſo be preſerved by the application of antiſeptics, as by ſalt, vinegar, and ſugar. Salt and vinegar are employed in common life, as for the uſe of ſailors, but ſugar is only employed in pharmacy, either to form the condita, or candies, in the production of which the vegetable ſubſtances are boiled in the ſugar; they are penetrated by the ſyrup, and inauſted with ſugar, or in the conſerves, in which the vegetable matter is beat into a pulp, and ſugar added to it. This practice of making conſerves is applicable to many vegetables, the virtues of which cannot be preſerved in any other way; ſuch as contain a volatile acid principle of an oily nature, as the ſcurvy-graſs, &c. other conſerves are kept which are intended for vehicles of more efficacious medicines. Theſe are remarkable for nothing but their agreeable taſte, at leaſt they poſſeſs very little virtue; as the conſervæ roſarum, florum roſmarini, corticis exterioris aurantiorum. Moſt of the ſyrups, honeys, jellies, &c. may be referred to this head: they are infuſions, or decoctions, to which ſugar is added to preſerve them from further change.

After having thus conſidered the means by which the artiſts preſerve the articles in the materia medica in a ſtate of perfection, we ſhall next take a view of the various operations he performs upon them; and all the operations of pharmacy may be brought under two great diviſions.

1. The preparatory operations. And,
2. The ultimate operations of pharmacy,

Under the first head are comprehended those by which the articles are either produced or extracted from the materials, or refined, or rendered otherways more active.

Under the second head, those operations by which the former are compounded variously or otherways adapted for the use of the patient.

MLXIX.

1. The purification of several substances is performed by colature, and has for its object commonly the concreted juices, or chiefly these. It is a simple purification of them from homogeneous substances. These juices are obtained from different plants by wounding them in different ways, so as to lay open different vessels for allowing them to exude their juices; and the dust, straws, and loose parts of the vegetables, from which these are extracted, are mixed with these juices, while suffering inspissation; so when we bring opium into fluidity, and pass it through a coarse cloth, a great quantity of the heterogenous particles are separated from it. Some of these concreted juices cannot be brought into fluidity by water, but must be liquified by means of heat, as turpentine, animal fat, &c.

MLXX.

2. The pulverization of substances is one of the most simple and generally practised operations in pharmacy; the uses of it are evident on numberless occasions, to prepare substances for being swallowed and digested, to increase their surface that the humours of the stomach may act readily upon them, to prepare them for being easily divided into drops of different kinds, and for being mixed with one another in composition. This is so often necessary in pharmacy, that some branches of it have become separate articles; so the Peruvian bark is reduced to powder by means of a machine which is driven by horses, or water, as also the absorbent earths, of which great quantities are employed in pharmacy. This is a saving of labour, and

it affords the pulverized matter at a cheap rate: but in the form of powder it is difficult to be certain whether it may not be mixed with ſome other ſubſtance, whereas, in its original ſtate we can judge whether it is pure or not.

Pulverization, as performed by the apothecary, is either done by pounding in the mortar, or by levigation on the porphory. It is promoted by ſifting, and in ſome caſes by elutriation with water, where the ſubſtance bears its application without any change of its qualities, the turbid water is poured off, taking along with it the moſt ſubtile part. The tough fibrous part of vegetables is incapable of levigation, and requires pounding or braying in a mortar, while theſe ſubſtances of a brittle nature are beſt reduced to a powder by levigation.

The pounding has this inconvenience, that the fine powder is liable to fly out of the mortar, whereby a quantity of it is loſt, and it is in danger of hurting the health of the operator, as in the pulverizing cantharides, &c. The artiſt generally ſaves himſelf by tying a cloth or other ſpongy matter over his face, through which he obliges himſelf to breathe; but this is an imperfect remedy, and he oftens ſuffers conſiderably from the action of the acrid ſubſtances. A remedy might be found out for this, by forming a communication between the mortar and the large cavity of a barrel, to allow the air which is driven out, a place to circulate and depoſit the ſubtile particles. The manner it comes out is plain; every time the peſtle is drawn up there is a vacuity into which the external air iſſues, and when the peſtle is thrown down it expels this air, which riſes out and carries along with it the ſubtile particles, which are ſet afloat by the conſtant agitation. It may be poſſible, by a communication formed between the mortar and the cavity of this kind, to allow the motion without the operator being troubled by the ſubtile duſt; or a ſmall quantity of fluid may be added, which prevents theſe ſubtile parts from riſing ſo readily; and this may do in the caſe of earthy bodies or metallic calces, but with regard to moſt vegetables, it would diſpoſe them to cohere together. The ſieves ſhould, in general, be

covered, and they ſhould be exceedingly fine, eſpecially for the more acrid vegetable ſubſtances, which are of a purgative nature; for unleſs they are reduced to a fine powder, the particles adhere to the coats of the inteſtines, and increaſe the irritation they occaſion there. It is commonly given as a rule in pounding roots, woods, and barks, to cut theſe ſubſtances with a ſharp knife, whereby the operation is greatly facilitated. With regard to the gummy and reſinous ſubſtances they are liable to acquire a degree of tenacity, ſo we avoid beating them with much violence, which would produce a degree of heat, and it is eligible to reduce them to powder in cold weather when they are more brittle. Some ſubſtances are more eaſily reducible to powder by the addition of ſpirit of wine; as in the caſe of camphire, one of the moſt important general rules is, that when a ſubſtance is powdered it ſhould be done totally; as in powdering ipecacuan, bark, &c. if we only pound the half to a fine powder, and lay by the reſt, we ſhall obtain a powder, the virtues of which will not anſwer to thoſe of the vegetable ſubſtance in its entire ſtate, the reſinous part being more eaſily reduced to powder while the woody fibres remain the laſt; therefore to have them of an equal efficacy, the whole muſt be brought to the ſtate of a powder, and mixed together.

The other method of levigation applies to earthy matter, or brittle metallic products; theſe bear the addition of water or other fluids without any change, and are reducible to a very fine powder.

MLXXI.

Such ſubſtances as have ſome toughneſs may be managed by filing or granulation. Iron is generally taken in the form of filings, but it may be reduced to a fine powder, which is a particular mode of ruſting the iron filings. We ſpread them in a ſhallow veſſel covered with water and expoſed to the air, whereby they are divided into a ſubtile black powder, but they muſt be covered with water, otherwiſe the powder becomes a ruſt of iron, ſo it is a mean for inducing a ſort of metallic diſſolution.

By elutriation too, the powder may be rendered finer, but this is especially uſed for boles and chalk: the boles are natural clays which are tinctured with iron; but in their natural ſtate they contain ſand, as there is no clay earth without ſand. In order to have it free of ſand, which is very pernicious, it is beſt done by elutriation. In like manner chalk contains pyrites, flint, and other ſubſtances, but which is neceſſary to be ſeparated from it.

After having thus conſidered two of the moſt general of the preparatory operations of pharmacy, we would next take a view of theſe which are more particular, arranging them according to the ſame method obſerved in the former part. On this plan we enter upon the exhibition of the airs.

MLXXII.

Class I. *Modes of exhibiting Airs.*

The introduction of airs is new in pharmacy, and Mr. Watts' apparatus is the only mode of exhibiting them yet reſorted to. This apparatus conſiſts of an alembic, of a long pipe, conducting to the refrigeratory, of a refrigeratory of conſiderable ſize, of a hydraulic bellows, into which the gas is conveyed from the refrigeratory in order that it may be farther cooled, and of an air holder, into which a transfer pipe diſcharges the air from the hydraulic bellows. (Vide Bedoes on Airs, part II. p. 3.)

MLXXIII.

Vital Air.

Vital air is procured by expoſing ſimply black oxyd of manganeſe to a red heat, or by mixing it with two parts and a half of ſulphuric acid, adding a moderate heat, when a large quantity of this air is ſeparated. When freſh made it is rather unfit for medical uſe, as containing in it a quantity of the manganeſe ſuſpended, and ſome cauſtic lime ſhould therefore be well mixed in the water of the refrigeratory, or it ſhould be kept 12 hours in the air holder before it is uſed. In uſing it is ſometimes employed, in urgent caſes, undiluted but more com-

monly it is mixed with atmoſpheric air, from 20, 30, to 50 quarts of atmoſpheric air with two of vital air, employed once a day, is a common courſe in chronic diſeaſes, gradually leſſening the frequency of its application, according to circumſtances, and even intermitting occaſionally, when general appearances of inflammation, as a white tongue, &c. appear.

The effect of this doſe is to diffuſe a ſenſe of warmth through the body, and to occaſion a ſuffuſion of colour over every part, and to render the pulſe ſlower and fuller.

MLXXIV.

Dephlogiſticated Nitrous Air

Is obtained by expoſing nitrous gas to wetted iron filings, or moiſt ſulphuret of alkali. It may be inhaled either pure, or in a varied proportion with atmoſpheric air, according to circumſtances.

MLXXV.

Carbonic Acid Gas, or Fixed Air,

Is obtained in its pureſt ſtate, by heating chalk or calcarious ſubſtances red hot, and admitting to it ſmall quantities of water, by which the fixed air will be diſengaged; or it may be procured by pouring dilute ſulphuric acid on chalk, and allowing the gas to paſs through water, and be inſpired through a tube in that ſtate.

Theſe inhalations may take place for 20 minutes, occaſionally breathing an inhalation of atmoſpheric air, and they may be repeated four or five times a day, unleſs pain of cheſt, or other ſymptoms ariſe, that occaſion it to be deſiſted from.

MLXXVI.

Hydro Carbonate Air

Is a modification of the former, and procured by heating charcoal to redneſs, and dropping water upon it. The water ſhould be admitted very ſlowly, and lime ſhould be mixed in the water of the refrigeratory, to prevent any contamination in the proceſs, and this air is

beſt uſed freſh made. From the great powers of this air it requires, in uſing it, that the doſe be meaſured out with great accuracy, and its proportion ſhould not be more than one part to 15 of atmoſpheric air.

The utmoſt care ſhould be taken in preparing it that the charcoal be previouſly well calcined.

MLXXVII.

The exhibition of airs is ſtill as medicines in an undetermined ſtate. Their palliative powers are clearly proved, their radical efficacy is uncertain. To facilitate their exhibition, an arrangement of different ſtandards or changes of atmoſpheric air has been propoſed by Dr. Bedoes in the following manner:—

Thus 28 parts being the proportion of vital air uſually preſent in the atmoſphere, he has altered it by the addition of ſucceſſive equal parts of it to one of oxygen, thus:—

TABLE I.

		Oxygen.	Azotic.
1 part of atmoſpheric	to 1 of oxygen	64	36
1 of atm.	to do.	52	48
3 do.	to do.	46	54
4 do.	to do.	42	58
5 do.	to do.	40	60
6 do.	to do.	38	62
7 do.	to do.	37	63
8 do.	to do.	36	64
9 do.	to do.	35	65
10 do.	to do.	34½	65½
11 do.	to do.	34	66
19 do.	to do.	30¼	62½

TABLE II.

The ſtandard is altered in the following manner, by addition of ſucceſſive equal parts of oxygen to one of atmoſpheric air:

		Oxygen.	Azotic.
2 oxygen	to 1 atmoſpheric	76	24
3 oxygen	to do.	81	19

		Oxygen.	Azote.
4 oxygen	to 1 atmospheric	85	15
5 do.	to do.	88	12

TABLE III.

Effect of the addition of different portions of atmospheric to one of unrespirable air.

		Oxygen.	Unrespir.
1 atmospheric	to 1 unrespirable	14	86
2 do.	to do.	19	81
3 do.	to do.	21	79
4 do.	to do.	22	78
5 do.	to do.	23	77
6 do.	to do.	24	76
7 do.	to do.	24	76
8 do.	to do.	25	75
9 do.	to do.	25	75
0 do.	to do.	25½	74½

TABLE IV.

Effect of the addition of different portions of unrespirable airs to one of atmospheric.

		Oxygen.	Unrespir.
1 atmospheric	to 2 unrespirable	9	91
1 do.	to 3 do.	7	93
1 do.	to 4 do.	5½	94½
1 do.	to 5 do.	5	95

The higher ſtandard of atmoſphere is chiefly exhibited in ſpaſmodic diſeaſes, particularly of the cheſt, and where the powers of the ſmaller veſſels are in a ſtate of a tonic weakneſs, as in dropſy. The lower table has been more variouſly modified, according to the circumſtances of the diſeaſe. In phthiſis an exceſs of carbonic acid gas has been recommended in the day, and the inſpiration of hydrogen at night.

MLXXVIII.

CLASS II. *Modes of exhibiting Waters.*

Waters are of two kinds, ſimple and compound.

MLXXIX.

Simple.

Simple water is that freed from all extraneous matter, either by diftillation or filtration ; as

MLXXX.

AQUA DISTILLATA.

Lond.

Diftilled Water.

Take of

Spring water, ten gallons.

Draw off by diftillation, firft, four pints; which being thrown away, draw off four gallons. This water is to be kept in a glafs or earthen bottle with a glafs ftopper.

AQUA DISTILLATA.

Edin.

Diftilled Water.

Let fpring or well water be diftilled in very clean veffels till about two thirds are drawn off.

Moft medicines are made up with diftilled water, which fhould be kept in a clofe veffel. Filtration may be conducted equal to diftillation for procuring water in a pure ftate, when it is paffed through a bed of charcoal, according to a new apparatus invented for this purpofe, and for which a patent is obtained.

MLXXXI.

Compound.

The compound waters ufed in medicine, or thofe impregnated with various fubftances, may be divided into the mineral waters, and diftilled.

MLXXXII.

Mineral Waters.

The artificial impregnation of water, fo as to anfwer the purpofe of the natural mineral fprings, defcribed in the former part, is of much importance, and this is eafily done by an accurate knowledge of their ingredients.

MLXXXIII.

Acidulous Waters.

The firſt claſs, or the acidulous waters, depend entirely on the carbonic acid, as their active principle, and they contain from $\frac{1}{100}$ part to a quantity equal to their bulk of it. They are prepared by Dr. Nooth's machine, which has ſince received the ſucceſſive improvements of Parker and Magellan. The materials, conſiſting of chalk or marble, and diluted ſulphuric acid, are then to be ſucceſſively introduced into its lower part, the latter firſt. The effervefcence will then begin, and the impregnation take place. A proportion of neutral ſalts may be afterwards diſſolved in the water. Thus in order to make the Seltzer, 6 grains of carbonate of magneſia, 5 grains of mineral alkali, and 22 grains of muriated ſoda are to be added for each pint of water. By aſcertaining the proportions of the neutral ſalts in each water the ſame imitation may be made.

MLXXXIV.

Saline Waters.

The active ingredients in this claſs of waters is either the ſulphate of magneſia, or elſe ſulphate of ſoda. In the Epſom mineral a pint contains two ſcruples of ſulphate of magneſia, and in this proportion it may be imitated. In ſea-water the preparations are, in a pint, of muriate of ſoda 186 grains, of muriate of magneſia 51 grains, and of ſulphate of lime 7 grains. But the ſulphate of magneſia is the active ingredient.

MLXXXV.

Sulphureous Waters.

The ſulphureous hydrogen is the diſtinguiſhing ingredient of this claſs, united with a proportion of carbonic acid gas and azote. The Aix water is one of the moſt powerful of this claſs, and it may be imitated by firſt impregnating the water with carbonic acid, then adding a dram or two of hepar ſulphuris, or alkaline

fulphuret, in powder, with fulphuric acid; and the gazeous quality being thus imparted, add to each pint 6 grains of muriate of foda, 14 grains of carbonate of foda, and 5 grains of carbonate of lime.

MLXXXVI.

Chalybeate Waters

Are diftinguifhed by their proportion of iron generally diffolved in carbonic acid. They are therefore a mixture fometimes of the acidulous, fometimes of the faline, fometimes of both waters, holding a folution of fteel; and to imitate them, it is only neceffary to fufpend two or three plates of iron in the water, when impregnating it with carbonic acid, the faline ingredients may then be added, which in the Pyrmont water are 9 grains of carbonate of magnefia, 5 grains of fulphate of magnefia, and 2 grains of muriate of foda, to every pint.

MLXXXVII.

By preparing the mineral waters in a clofe metallic veffel, they may be procured of any temperature.

That this fubject of the operation of the ingredients contained in the principal mineral waters in ufe may be fhewn at one view, and thus render their artificial imitation eafy, a fynoptical table is given of them, chiefly extracted from Dr. Saunders' work.

A SYNOPTICAL TABLE.

CLASS.	NAME.	Higheſt temp. — Fahren.	Contained in an Engliſh wine pint of 28.875 cubic inches. Azotic gas. — cub. in.	Carbon. acid gas. — cub. in.	Sulph. hydrog. — cub. in.	Carbon. ſoda. — grains.	Neutral purging ſalts. — grains.	Selenite and earthy carbonats. — grains.	Oxyd of iron. — grains.	DOSES.
Simpler cold	Malvern			uncert.	none	none	uncert.	uncert.	none	At pleaſure.
	Holywell				none	none	uncert.	uncert.	none	Quarter of a pint twice a day
Simpler thermal	Briſtol	74°	uncert.	3.75	none	none	2.81	3.16	none	Ditto.
	Matlock	66°		uncert.	none	none	uncert.	uncert.	none	At pleaſure.
	Buxton	82°	0.474	uncert.	none	none	0.25	1.625	none	$\frac{1}{3}$ of a pint, before breakfaſt and dinner.
Simple ſaline	Sedlitz			1.	none	none	185.6	8.68	none	A pint a doſe.
	Epſom				none	none	40.[illegible]	8.[illegible]	none	2 to 3 pints.
	Sea				none	none	237.5	6.	none	$\frac{1}{2}$ pint to a pint.
Highly carbonated alkaline	Seltzer			17.	none	4.	17.5	8.	none	$\frac{1}{2}$ pint to a pint.
Simple carbonated chalybeate	Tunbridge		0.675	1.325	none	none	0.344	0.156	0.125	$\frac{1}{2}$ pint thrice a day.
Hot, carbonated [illegible]	Bath	116°	1.[illegible]	1.[illegible]	none	none	[illegible]	10.[illegible]	uncert.	$\frac{1}{2}$ pint thrice a day.

A SYNOPTICAL TABLE.

Class.	Name.	Highest temp. — Fahren.	Contained in an English wine pint of 28.875 cubic inches. Azotic gas. — cub. in.	Carbon. acid gas. — cub. in.	Sulph. hydrog. — cub. in.	Carbon. soda. — grains.	Neutral purging salts. — grains.	Selenite and earthy carbonats. — grains.	Oxyd of iron. — grains.	Doses.
Highly carbonated chalybeate	Spa			12.79	none	1.47	4.632	1.47	0.56	$\frac{1}{2}$ pint thrice a day.
	Pyrmont			26.	none	none	7.13	23.075	0.46	The same.
Saline carbonated chalybeate	Cheltenh.		uncert.	5.687	uncert.	none	62.125	6.85	0.625	Dose $\frac{1}{2}$ pint.
	Scarbro'			uncert.	none	none	20.	10.	uncert.	The same.
Hot, saline, highly carb. chalybeate	Vichy	120° ?		uncert.	none	uncert.		uncert.	uncert.	The same
	Carlsbad	165°		uncert.	none	11.76	47.04	4.15	uncert.	The same.
Vitriolated chalybeate	Hartfell				none	none	none	none	4.815*	Pint in the day.
Cold sulphureous	Harrogate		0.875	1.	2.375	none	91.25	3.	none	2 pints a day.
	Moffat		0.5	0.625	1.25	none	4.5	none	none	Ditto.
Hot, alkaline, sulphureous	Aix	143°		uncert	uncert.	12.	5.	4.75	none	Half a pint.
	Bariet	132°		uncert.	uncert.	uncert.	uncer.		none	The same.
	Barege	120°			uncert.	2.5	0.5	uncert.	none	The same.

* That is, 2.94 contained in the sulphate of iron, (this salt when crystallized containing 28 per cent. of oxyd of iron, according to Kirwin) and 1.875 additional of oxyd of iron.

MLXXXVIII.

Distilled Waters.

Distilled waters consist of those impregnated with the aromatic parts of certain vegetables, and this impregnation is procured by distillation, which is performed in three ways, by the cold still, by the hot still, and by the union of both.

The first method consists in filling a shallow leaden vessel with the fresh herbs and flowers, which are heaped above it; so that when the head is fitted on, this also may be filled a considerable way. A little fire is made under the vessel, sufficient to make the bottom much hotter than the hand can bear, care being only taken not to heat it so far as to endanger scorching any part of the subject. If the bottom of the vessel be not made so hot as to have this effect on the part contiguous to it, there is no fear that the heat communicated to the rest of the included matter will be so great as to do it any injury. By this management, the volatile parts of the several odorous plants, as mint, are effectually forced over; and if the process has been skilfully managed, the distilled liquor proves richly impregnated with the native odour and flavour of the subject, without having received any kind of disagreeable impression from the heat used.

This method is too slow for the dispatch of business, and therefore the hot still is more employed. This consists in adding to the plant a quantity of water, to prevent its burning; and the liquor is kept nearly of a boiling heat, or made to boil fully, so that the vapour rises plentifully into the head, and passing thence into a spiral pipe or worm placed in a vessel of cold water, is there condensed, and runs out in drops quickly succeeding each other, or in a continued stream. The additional water does not at all weaken the produce; for the most volatile parts of the subject rise first, and impregnate the liquor that first distils: as soon as the plant has given over its virtue sufficiently, which is known by examining from time to time the liquor that runs from the nose of the worm, the distillation is to be stopped.

This method though moſt proper for the officinal preparations, from the degree of heat employed, is apt to injure thoſe plants of a more delicate flavour, and on this account for the latter the compound method is preferred, by which are obviated the inconveniences of the former. A quantity of water being poured into the ſtill, and the herbs or flowers placed in a baſket over it, there can be no poſſibility of burning; the water may be made to boil, but ſo as not to riſe up into the baſket, which would defeat the intention of this contrivance. The hot vapour of this water paſſes gently through all the interſtices of the ſubject matter, imbibes and carries over the volatile parts unaltered in their native flavour. By this means the diſtilled water of all thoſe ſubſtances whoſe oils are of the more volatile kind, are obtained in the utmoſt perfection, and with ſufficient diſpatch.

MLXXXIX.

In making diſtilled waters, the rules to be obſerved are:

1. That freſh herbs be diſtilled with three times their weight of water, but dry ones require a much larger quantity; and as no invariable rule can be offered, the diſtillation ſhould be always continued ſo long as the liquor runs well flavoured.

2. The diſtillation may be either conducted in a common ſtill, or in an alembic and refrigeratory, with the junctures well luted.

3. The diſtillation of the water is ſucceeded by an acid liquor coming over, which frequently oxydates part of the veſſel.

4. Oil ſhould be carefully taken off from the ſurface of the diſtilled water.

5. In order that ſuch diſtilled waters may keep, a $\frac{1}{20}$ part of proof ſpirit has been directed to be added to them, or half an ounce to each pound.

The liſt of diſtilled waters is now much leſſened in practice. They are employed chiefly as grateful diluents, as ſuitable vehicles for medicines of greater efficacy, or

for rendering disgustful ones more acceptable to the palate and stomach. Few are depended on, with any intention of consequence, by themselves.

AQUA ANETHI.
Lond.
Dill Water.

Take of
Dill-seed, bruised, one pound;
Water, sufficient to prevent an empyreuma.
Draw off one gallon.

AQUA SEMINUM ANETHI.
Edin.
Dill-seed Water.

Take of
Dill-seeds, [illegible] pound;
Pour on as much water as when ten pounds have been drawn off in distillation, there may remain as much as is sufficient to prevent an empyreuma.
After proper maceration, let ten pounds be drawn off.

In this water two colleges pretty much agree. Though a powerful impregnation, it is little employed as a carminative, from its flavour being less agreeable than some others.

AQUA CINNAMOMI.
Lond. Ed.
Cinnamon Water.

Take of
Cinnamon, bruised, one pound;
Water, sufficient to prevent an empyreuma.
Macerate for 24 hours, and draw off one gallon.

This water the most cordial and fragrant of the whole, when made from cinnamon and not cassia, requires a quick fire and low vessel; and in order to prevent the separation of its oil afterwards, a small addition of sugar.

AQUA CASSIÆ LIGNEÆ.
Edinb.
Cassia Water.

From a pound and half of the cassia bark, ten pounds of water are directed to be drawn off in the same manner as the dill water.

This is prepared oftener from the buds than bark, and is a common ſubſtitute for the former, to which from the ſtrength of its impregnation it is not inferior.

AQUA FÆNICULI.
Lond.
Fennel Water.

Take of
Sweet fennel-ſeeds, bruiſed, one pound;
Water ſufficient to prevent an empyreuma.
Draw off one gallon.

This water is a pleaſant carminative, and better prepared from the ſeeds than any other part of the plant.

AQUA MENTHÆ PIPERITIDIS.
Lond.
Peppermint Water.

Take of
Peppermint, dried, one pound and an half;
Water, ſufficient to prevent an empyreuma.
Draw off one gallon.

This is a pungent uſeful cordial in flatulence and colic, taken from half an ounce to an ounce. It may be prepared alſo by the eſſential oil and water, with the intervention of ſugar.

Edinb.

From three pounds of freſh peppermint in flower, ten pounds of water are to be drawn off.

AQUA MENTHÆ SATIVÆ.
Lond.
Spearmint Water.

Take of
Spearmint dried, one pound and an half;
Water, ſufficient to prevent an empyreuma
Draw off one gallon.

This water is much uſed warm againſt weakneſs of ſtomach and vomiting.

AQUA PIMENTO.
Lond. Edinb.
All-Spice Water.

Take of
All ſpice, bruiſed, half a pound;
Water, ſufficient to prevent an empyreuma.
Macerate for 24 hours, and draw off one gallon.

This water is a warm, uſeful carminative, and is much employed, from its cheapneſs, in hoſpital practice.

AQUA PULEGII.

Lond. Edinb.

Penny-Royal Water.

Take of
Dried penny-royal, one pound and a half;
Water, ſufficient to prevent an empyreuma.
Draw off one gallon.

The penny-royal water is now little uſed, though formerly much reſpected in hyſterical caſes.

AQUA ROSÆ.

Lond. Edinb.

Roſe Water.

Take of
Freſh petals of the damaſk roſe, the white heels being cut off, ſix pounds;
Water, ſufficient to prevent an empyreuma.
Draw off one gallon.

This water is only valued for its agreeable flavour, as its impregnation is not ſufficient to poſſeſs the particular quality of the leaves in their concentrated ſtate.

AQUA CORTICIS LIMONUM RECENTIUM.

Edinb.

Lemon peel Water.

From two pounds of recent lemon-peel, ten pounds of water are to be drawn off by diſtillation.

AQUA CORTICIS AURANTIORUM HISPALENTIUM RECENTIUM.

Edinb.

Orange-peel Water.

From two pounds of recent orange-peel, ten pounds of water are to be drawn off by diſtillation.

Thoſe waters are employed in diſorders of the ſtomach and palate, as well as a diluent in fever; but from the ſlightneſs of their impregnation little confidence is placed in them.

AQUA ALEXITERIA.
Brun.
Alexiterial Water.

Take of
- Elder flowers, moderately dried, three pounds;
- Angelica leaves, fresh gathered, two pounds,
- Spring water, forty pounds.

Draw off, by distillation, thirty pounds.

This is a simple, elegant water, much used as a vehicle in making other medicines.

AQUA CAMPHORÆ.
Brun.
Camphor Water.

Take of
- Camphor, an ounce and an half.

Let it be dissolved in half an ounce of spirit of rosemary, then pour on it two pounds of spring water, and draw off by distillation a pound and an half.

The introduction of this medicine in the diluted state of a water has been tried with great advantage.

AQUA CASTOREI.
Brun.
Castor Water.

Take of
- Russia castor, one ounce;
- Water, as much as will prevent burning.

Draw off two pints.

As water receives a full impregnation of this medicine whose virtues reside in an essential oil, it is properly introduced in this form in hysteric and other nervous cases, though its qualities are impaired by keeping.

AQUA CEREFOLII.
Gen.
Chervil Water.

Take of
- Fresh leaves of chervil one pound;
- Spring water, as much as is sufficient for allowing eight pounds to be drawn off by distillation, at the same time avoiding empyreuma.

Though an elegant form of exhibiting the medicine, it is inferior in its virtue as a diuretic, to the substance, or expressed juice.

AQUA CERASI.

Suec.

Black Cherry Water.

Take of
Ripe black cherries, bruifed with the kernels, twenty pounds;
Pure water, as much as is fufficient for avoiding empyreuma.
Draw off twenty pounds by diftillation.

This is often ufed as a vehicle for other medicines, efpecially in the convulfions of infancy; but it is alleged at the fame time to poffefs fomething of a poifonous nature, and to refemble the lauro cerafus.

AQUA CHAMOMELI.

Dan.

Chamomile-flower Water.

Take of
Chamomile flowers, dried in the fhade, eight pounds;
Water, feventy-two pounds.
Draw off by gentle diftillation forty-eight pounds.

This water requires fome previous fermentation of the flowers before being diftilled, and they give over in this form the fmell and flavour of the medicine, without any of the bitternefs. It is a remedy in flatulent cholic and other fimilar complaints.

AQUA FRAGORUM.

Suec.

Strawberry Water.

From twenty pounds of ftrawberries twenty pounds of diftilled water are drawn off, according to the fame directions given for the preparation of the black cherry water.

The agreeable flavour of this form is its only recommendation.

AQUA HYSSOPI.

Suec.

Hyffop Water.

From four pounds of the frefh leaves of hyffop, fix pounds of water are drawn off.

This water has been efteemed as a uterine and pectoral medicine, but on no juft foundation.

AQUA LILIORUM ALBORUM.

Brun

White Lily Water.

To any quantity of these flowers, four times their weight of water is to be added, and water drawn off by distillation in the proportion of two pounds to each pound of the flowers.

This water resembles the odour of the growing flowers, but is of no particular application in disease.

AQUA MELISSÆ.

Brun.

Balm Water.

The green leaves of the balm are to be macerated with double their weight of water; and from each pound of the plant a pound and an half of water is to be drawn off.

This water has been recommended in nervous cases, on an empty stomach, but does not appear to deserve the character.

AQUA RUTÆ.

Ross.

Rue Water.

From each pound of rue, with a sufficient quantity of spring water to prevent an empyreuma, two pounds of distilled water are to be drawn.

This form possesses both the smell and pungency of the vegetable, and is therefore active in these nervous cases, and other affections from interrupted discharge, where the substance itself is employed.

AQUA SABINÆ.

Brun.

Savin Water.

This is distilled from the fresh leaves of savin, after the same manner as the former.

This water possesses much the same qualities as the former, and is employed in much the same cases.

AQUA SAMBUCI.

Brun.

Elder-flower Water.

This is distilled from fresh elder flowers, after the same manner as the white lily water.

This water is seldom used, though strongly fragrant of the flowers.

AQUA SALVIÆ.

Brun.

Sage Water.

This is directed to be prepared from the green leaves of the ſage, in the ſame manner as the balm water.

This water contains all the virtues of the ſimple, and an infuſion can be eaſier made, and is equally powerful.

Diſtilled Spirits.

Theſe are formed by the ſolution of the eſſential oil of vegetables in alcohol, which keeps it by diſtillation ſuſpended, inſtead of its ſeparating from its menſtruum, as in the waters.

To render theſe ſpirits fit for the purpoſes of medicine, the alcohol, or rather proof ſpirit, ſhould be rectified as directed in p. 127 and 190, and in the following receipts.

SPIRITUS VINI RECTIFICATUS.

Edinb.

Rectified Spirit of Wine.

Take any quantity of French brandy, and with a very gentle heat diſtil it to one half.

This rectified ſpirit, being digeſted for two days with one fourth its quantity of dry ſalt of tartar in powder, and then diſtilled in a glaſs cucurbit with a very gentle heat, becomes ALCOHOL.

Spirits diſtilled from malt liquors, or other fermented ſubſtances, after being rectified in the above method, require further purification; namely, repeated diſtillation from an equal quantity of ſpring water.

Having thus procured a proper rectified ſpirit, it becomes fit for the various compoſitions to be detailed.

SPIRITUS VITRIOLI DULCIS.

Lond.

Dulcified Spirit of Vitriol.

Take of

Rectified ſpirit of wine,

Vitriolic acid, each one pound.

Pour in by a little at a time the acid to the ſpirit, and mix them by ſhaking; then from a retort into a tubulated receiver, to which another recipient is fitted, diſtil the ſpirit of vitriolic æther till ſulphureous vapours begin to riſe.

ACIDUM VITRIOLICUM VINOSUM vulgo SPIRITUS VITRIOLI DULCIS.

Edinb.

Vinous Vitriolic Acid, commonly called *Dulcified Spirit of Vitriol.*

Take of

Vitriolic æthereal liquor, one part:

Rectified spirit of wine, two parts.

Mix them.

This medicine we have already noticed in p. 192, and its mode of preparation. It is greatly used both as a menstruum and a medicine. It is the best solvent of any substance of a resinous and saponaceous nature. As a medicine the discharges by the skin and kidneys are promoted by it, and it relieves pain, spasm, and flatulence. Its dose is from 10 to 80 or 90 drops in a proper vehicle.

ÆTHER VITRIOLICUS.

Lond.

Vitriolic Æther.

Take of

The spirit of vitriolic æther, two pounds;

Water of pure kali, one ounce.

Shake them together, and distil, with a gentle heat, fourteen ounces by measure.

LIQUOR ÆTHEREUS VITRIOLICUS.

Edinb.

Vitriolic Æthereal Liquor.

Take of

Rectified spirit of wine,

Vitriolic acid, of each thirty-two ounces.

Pour the spirit into a glass retort fit for sustaining a sudden heat, and add to it the acid in an uniform stream. Mix them by degrees, frequently shaking them moderately: this done, instantly distil from sand previously heated for that purpose, into a receiver kept close with water or snow. But the heat is to be so managed, that the liquor shall boil at first, and continue to boil till sixteen ounces are drawn off; then let the retort be raised out from the sand.

To the distilled liquor add two drams of the causticum commune acerrimum; then distil again in a highly raised retort, with a very gentle heat, into a cool receiver, until ten ounces have been drawn off.

If sixteen ounces of rectified spirit of wine be poured upon the acid remaining in the retort after the first distillation, an ætherial liquor may be obtained by repeating the distillation. This may be done pretty often.

This is the most volatile of all spirits, and inflammable

of all liquids, capable of the most sudden evaporation, and forming a powerful solvent of oils, balsams, and resins. Its progressive odour is largely diffused. As a medicine it is much employed in spasmodic cases, as tooth-ach, head-ach, and asthma. Its dose extends from a few drops to half an ounce, in a glass of wine or water, to be immediately swallowed.

SPIRITUS ÆTHERIS NITROSI.

Lond.

Spirit of Nitrous Æther.

Take of

Rectified spirit of wine, two pints;

Nitrous acid, half a pound.

Mix them, by pouring in the acid to the spirit, and distil, with a gentle heat, one pound ten ounces.

ACIDUM NITRI VINOSUM; vulgo SPIRITUS NITRI DULCIS.

Edinb.

Vinous Acid of Nitre, commonly called *Dulcified Spirit of Nitre.*

Take of

Rectified spirit of wine, three pounds;

Nitrous acid, one pound.

Pour the spirit into a capacious phial, placed in a vessel full of cold water, and add the acid by degrees, constantly agitating them. Let the phial be slightly covered, and laid by for seven days in a cool place; then distil the liquor, with the heat of boiling water, into a receiver kept cool with water or snow, till no more spirit comes over.

This dulcified spirit of nitre is much used in promoting the excretions and fortifying the stomach. It is given from a few drops to a dram. With a proportion of alkaline spirit it forms a powerful diaphoretic, and occasionally diuretic. Added in small quantities to malt spirits, it gives the flavour of brandy.

SPIRITUS AMMONIÆ.

Lond.

Spirit of Ammonia.

Take of

Proof-spirit, three pints;

Sal ammoniac, four ounces;

Pot-ash, six ounces.

Mix, and distil, with a slow fire, one pint and a half.

SPIRITUS SALIS AMMONICI VINOSUS.

Edinb.

Vinous Spirit of Sal Ammoniac.

Take of

Quicklime, fixteen ounces;
Sal ammoniac, eight ounces;
Rectified fpirit of wine, thirty-two ounces.

Having flightly mixed the quicklime and ammoniacal falt, put them into a glafs retort; then add the fpirit, and diftil in the manner directed for the volatile cauftic alkali, till all the fpirit has paffed away.

This folution of volatile alkali in fpirit of wine is ufed as a menftruum for effential oils and to form a variety of tinctures. As a medicine its qualities are only thofe of the volatile alkali.

SPIRITUS AMMONIA FOETIDUS.

Lond.

Fetid Spirit of Ammonia.

Take of

Proof-fpirit of wine, fix pints;
Sal ammoniac, one pound;
Afafœtida, four ounces;
Pot-afh, one pound and an half.

Mix them, and draw off by diftillation five pints, with a flow fire.

Edinb.

Take of

Vinous fpirit of fal ammoniac, eight ounces;
Afafœtida, half an ounce.

Digeft in a clofe veffel twelve hours; then diftil off, with the heat of boiling water, eight ounces.

This fpirit is reckoned the moft ufeful anti-hyfteric medicine in practice. Its colour is improved by keeping.

AQUA MELISSÆ COMPOSITA.

Compound Balm Water, commonly called *Eau de Carmes.*

Take of

Balm in flowers, frefh gathered and cleared from the ftalks, two pounds;
Lemon-peel, frefh, as foon as pared from the fruit, four ounces;
Coriander feeds, eight ounces;
Nutmegs,
Cloves,
Cinnamon, each, bruifed, two ounces;
Angelica roots, dried and bruifed, one ounce;
Spirit of wine, highly rectified, ten pints.

Steep the feveral ingredients in the fpirit four or five days; and then draw off, in the heat of a water-bath, ten pints. Rectify the diftilla-

tion in a water-bath, drawing off only about eight pints and three quarters.

SPIRITUS RORISMARINI.

Lond.

Spirit of Rosemary.

Take of
Rosemary tops, fresh gathered, a pound and a half;
Proof spirit, one gallon
Distil in the heat of a water-bath till five pints are come over

Edinb.

' Take of
Flowering tops of rosemary, fresh gathered, two pounds;
Rectified spirit of wine, eight pounds.
Distil in the heat of boiling water till seven pounds are come over.'

This preparation is best conducted by th... we mentioned as the cold state under the class of waters. The Hungary water is a similar preparation.

SPIRITUS LAVENDULÆ SIMPLEX.

Lond.

Simple Spirit of Lavender.

Take of
Lavender flowers, fresh gathered, a pound and a half;
Proof-spirit, one gallon.
Draw off, by the heat of a wate-bath, five pints.

Edinb.

' Take of
Flowering spikes of lavender, fresh gathered, two pounds;
Rectified spirit of wine, eight pounds.
Draw off, by the heat of boiling water, seven pounds.'

SPIRITUS LAVENDULÆ COMPOSITUS.

Lond.

Compound Spirit of Lavender.

Take of
Simple spirit of lavender, three pints;
Spirit of rosemary, one pint;
Cinnamon,
Nutmegs, each half an ounce;
Red saunders, three drams.
Digest them together, and then strain out the spirit for use.

Edinb.

' Take of
Simple spirit of lavender, three pounds;
Simple spirit of rosemary, one pound;
Cinnamon, one ounce;
Cloves, two drams;

Nutmeg, half an ounce;
Red faunders, three drams.
Macerate feven days, and ftrain.'

This is a grateful, fragrant cordial: externally, rubbed on the temples, it proves a powerful ftimulus to the nerves of the fkin: internally, it is given in dofes of a tea-fpoonful as a ufeful cordial.

AQUA ODORIFERA.

An Odoriferous Spirit, called Sweet Honey Water.

Take of
Coriander feeds,
Honey, each one pound;
Cloves, an ounce and a half;
Nutmegs,
Banzoine,
Storax, each an ounce;
Vanelloes, in number four;
Yellow rind of three lemons;
French brandy, one gallon.

Digeft thefe ingredients together for forty-eight hours; and then diftil off the fpirit in balneo mariæ. To one gallon of this fpirit add,
Orange-flower water,
Rofe water, of each one pound and a half;
Ambergris,
Mufk, of each five grains.

Firft grind the mufk and ambergris with fome of the water, and afterwards put all together in a large mattrafs; fhake them well, and let them circulate for three days and nights in a gentle heat; then fuffer them to cool, filter the liquor, and keep it clofe ftopt up for ufe.

This water is a ufeful perfume.

SPIRITUS COCHLEARIÆ.

Edinb.

Spirit of Scurvygrafs.

Take of
Frefh fcurvygrafs, bruifed, ten pounds;
Rectified fpirit of wine, five pounds.

Steep the herb in the fpirit for twelve hours; then with the heat of a water-bath, diftil off five pints.

This preparation is extremely pungent, and its dofe from 20 to 100 drops has been recommended in dropfy. Its qualities are much diminifhed by expofure to the air.

AQUA ANHALTINA.

Anhalt Water.

Take of
Turpentine, fix ounces;
Olibanum, one ounce;

Aloes wood, three ounces;
Cloves,
Cinnamon,
Cubebs,
Rofemary flowers,
Galangal,
Maftich,
Nutmegs, each, fix drams;
Saffron, two drams and a half;
Bay berries,
Fennel feeds, each half an ounce;
Spirit of wine, five pints.

Pulverife thofe ingredients which require fuch treatment, and digeft the whole with the fpirit for fix days; then diftil, with an exceeding gentle heat, in balneo mariæ: the liquor which runs clear is to be feparated from the turbid, and kept by itfelf.

Where the addition of mufk is required, fifteen grains thereof are to be tied in a bag, and fufpended in the head of the ftill.

It is ufed externally in paralytic and rheumatic affections, and internally as a warm cordial.

AQUA ABSINTHII COMPOSITA.

Compound Wormwood Water.

Take of
Calamus aromaticus,
Orange-peel, frefh,
Cinnamon, each four ounces;
Roman wormwood, half a pound;
Mint, three ounces;
Leffer cardamoms,
Mace, each one ounce;
French brandy, two gallons.

Having bruifed the feeds and fpices, and cut the other ingredients, pour on them the brandy, and after fteeping them together for the fpace of four days, diftil off two gallons.

This is a powerful ftomachic.

AQUA CARVI SPIRITUOSA.

Edinb.

Spirituous Caraway Water.

' Take of
Caraway feeds, half a pound;
Proof-fpirit, nine pounds

Macerate two days in a clofe veffel; then pour on as much water as will prevent an empyreuma, and draw off by diftillation nine pounds.

In the ſame manner may be prepared nine pounds of ſpirituous diſtilled waters, from

Cinnamon, one pound;
Peppermint leaves, a pound and a half;
Nutmeg, well beat, two ounces;
Jamaica pepper, half a pound.

This forms a pleaſant and uſeful cordial.

AQUA ALEXETERIA SPIRITUOSA.
Lond.
Spirituous Alexeterial Water.

Take of
Spearmint leaves, freſh, half a pound;
Angelica leaves, freſh;
Sea wormwood tops, freſh, each four ounces;
Proof-ſpirit, one gallon;
Water, as much as will prevent burning.

Diſtil off one gallon.

AQUA ALEXETERIA SPIRITUOSA cum ACETO.
Lond.
Spirituous Alexeterial Water with Vinegar.

Take of
Spearmint leaves,
Angelica leaves, each half a pound;
Sea-wormwood tops, four ounces;
Proof-ſpirit, one gallon;
Water, as much as is ſufficient to prevent burning;
Vinegar, one pint.

Diſtil the freſh herbs with the ſpirit and water, drawing off one gallon; to which add the vinegar.

This forms a uſeful ſudorific.

AQUA SEMINUM ANISI COMPOSITA.
Lond.
Compound Aniſeed Water.

Take of
Aniſeeds,
Angelica ſeeds, each half a pound;
Proof-ſpirit, one gallon;
Water, as much as is ſufficient to prevent burning.

Draw off by diſtillation one gallon.

The medicine is appropriated to flatulent complaints, and is a uſeful cordial in debilitated ſtomachs, where digeſtion is impaired.

AQUA CARMELITANA.

Dan.

Carmalite Water, or Compound Balm Water.

Take of
- Fresh-gathered leaves of balm, a pound and a half;
- The recent yellow rind of lemons, four ounces;
- Nutmeg,
- Coriander, each two ounces;
- Cloves,
- Cinnamon, each one ounce.

The ingredients being sliced and bruised, pour upon them
- Rectified spirit of wine six pounds;
- Balm water, three pounds.

Digest for three days, then draw off six pounds by distillation.

This is the spirit of ratea, and to have it fine, a second distillation, or rather re-decomposition, is necessary; and to give it the flavor which all such spirits acquire by keeping, it should be plunged a short time into an extreme cold mixture, as pounded ice, and sea salt. In this way, by freezing them, are the distilled waters much improved.

AQUA CORTICUM AURANTIORUM SPIRITUOSA.

Lond.

Spirituous Orange-peel Water.

Take of
- Outer rind of Seville orange-peel, dried, half a pound;
- Proof-spirit, one gallon;
- Water, as much as is sufficient to prevent an empyreuma.

Distil off one gallon.

This is used as a powerful stomachic and carminative.

AQUA BRYONIA COMPOSITA.

Compound Bryony Water.

Take of
- Bryony roots, one pound;
- Wild valerian root, four ounces;
- Penny-royal,
- Rue, each half a pound;
- Mugwort leaves,
- Feverfew flowers,
- Savin tops, each one ounce;
- Orange-peel, fresh,
- Lovage seed, each two ounces;
- French brandy, two gallons and a half.

Having cut or bruised those ingredients which require such treatment, steep them in brandy four days; then draw off by distillation two gallons and a half of liquor.

This was considered formerly as a useful nervous medicine

AQUA VALERIANÆ COMPOSITA.
Edinb.
Compound Valerian Water.

Take of
Wild valerian root, a pound and a half;
Lovage feed, half a pound;
Pennyroyal leaves, four ounces;
Savin tops, two ounces;
French brandy, two gallons.
Digeft for two days, and then draw off by diftillation two gallons.

AQUA SEMINUM CARDAMOMI.
Lond
Cardamom Seed Water.

Take of
Leffer cardamom feeds, freed from the hufks, four ounces;
Proof-fpirit, one gallon;
Water, as much as is fufficient to prevent burning.
Diftil off one gallon.

This is a grateful aromatic cordial.

AQUA SEMINUM CARUI.
Lond
Caraway Water.

Take of
Caraway feeds, half a pound;
Proof-fpirit, one gallon;
Water, as much as will prevent burning.
Diftil off one gallon.

This is a common cordial of the fhops.

AQUA CINNAMONI SPIRITUOSA.
Lond.
Spirituous Cinnamon Water.

Take of
Cinnamon, a pound;
Proof-fpirit, a gallon;
Water, fo much as will prevent burning.
Draw off by diftillation one gallon.

The fpirit is reckoned more agreeable, and poffeffing more of the real flavor by adding to the aqua cinnamomi fimplex an equal part of proof-fpirit.

AQUA JUNIPERI COMPOSITA.
Lond.
Compound Juniper Water.

Take of
Juniper berries, one pound;
Sweet fennel feeds,
Caraway feeds, each an ounce and a half;

Proof-ſpirit, one gallon;
Water, as much as is ſufficient to prevent burning:
Diſtil off one gallon.

Edinb.

'Take of
Juniper berries, well bruiſed, one pound;
Seeds of caraway,
ſweet fennel, of each an ounce and a half;
Proof-ſpirit, nine pounds.
Macerate two days; and having added as much water as will prevent an empyreuma, draw off by diſtillation nine pounds.'

This ſpirit is chiefly to be uſed in caſes of dropſy from ſimple debility, without any fixed obſtruction.

AQUA MENTHÆ PIPERITIDIS SPIRITUOSA.
Lond.
Spirituous Pepermint Water.

Take of
Peppermint leaves, dry, a pound and a half;
Proof-ſpirit, a gallon;
Water, as much as is ſufficient to prevent an empyreuma.
Draw off by diſtillation one gallon.

This preparation is much employed in flatulent caſes, and is more proper than the water in violent ſpaſms from this cauſe.

AQUA MENTHÆ VULGARIS SPIRITUOSA.
Lond.
Spirituous Spearmint Water.

Take of
Spearmint leaves, dry, a pound and a half;
Proof-ſpirit, a gallon;
Water, as much as will prevent burning.
Diſtil off one gallon.

This is a uſeful medicine in chronic weakneſs of ſtomach attended with reaching, given in the doſe of half an ounce, diluted in any aqueous liquor.

AQUA MIRABILIS.

Take of
Cinnamon, two ounces;
Lemon-peel, one ounce;
Angelica ſeeds,
Leſſer cardamom ſeeds,
Mace, each half an ounce;
Cubebs, two drams;
Balm leaves ſix ounces;
French brandy, one gallon.

our the brandy on the other ingredients bruifed: and after digefting them for four days, draw off by diftillation one gallon.

AQUA AROMATICA, vulgo MIRABILIS.

Edinb.

Aromatic Water, commonly called *Aqua Mirabilis*.

Take of
- Cinnamon, two ounces;
- Frefh yellow rind of lemons,
- Angelica feeds, each one ounce;
- Mace, half an ounce;
- Peppermint, three ounces;
- French brandy, one gallon.

Digeft for two days, and then diftil off one gallon.

AQUA PIPERIS JAMAICENSIS SPIRITUOSA.

Spirituous Jamaica Pepper Water.

Take of
- Jamaica pepper, half a pound;
- Proof-fpirit, three gallons;
- Water, a fufficient quantity to prevent an empyreuma.

Draw off by diftillation three gallons.

These three waters are all warm cordials, and agree in their general qualities.

AQUA NUCIS MOSCHATÆ.

Lond.

Nutmeg Water.

Take of
- Nutmegs, two ounces;
- Proof-fpirit, a gallon;
- Water, as much as will prevent burning.

Draw off by diftillation one gallon.

This is a warm cordial prepared by the diftiller, and is ufed oftener as a cordial than a medicine.

AQUA POEONIÆ COMPOSITA.

Compound Peony Water.

Take of
- Peony roots, two ounces;
- Wild valerian roots, an ounce and a half;
- White dittany root, one ounce;
- Peony feeds, fix drams;
- Lilies of the vallies, frefh, four ounces;
- Lavender flowers,
- Rofemary flowers, each two ounces;
- Betony,
- Marjoram,
- Rue,
- Sage, tops of each, one ounce;

French brandy, a gallon and a half.

Cut or bruiſe thoſe materials that require ſuch treatment, ſteep them four days in the brandy, and then diſtil over a gallon and a half of liquor.

This was formerly eſteemed in epilepſy.

AQUA PULEGII SPIRITUOSA.

Lond.

Spirituous Penny-royal Water.

Take of

Penny-royal leaves, dry, a pound and a half;
Proof-ſpirit, a gallon;
Water, as much as will prevent burning.

Diſtil off one gallon.

Spirit of penny-royal is a good deal employed as a carminative and antihyſteric medicine.

AQUA RAPHANI COMPOSITA.

Lond.

Compound Horſe-radiſh Water.

Take of

Garden ſcurvygraſs leaves, freſh, four pounds;
Horſeradiſh root, freſh,
Orange peel, freſh, each two pounds;
Nutmegs, nine ounces;
Proof-ſpirit, two gallons;
Water, ſufficient quantity to prevent burning.

Draw of by diſtillation two gallons.

Edinb.

Take of

Horſeradiſh root,
Garden ſcurvygraſs, freſh, each three pounds;
Orange peel, freſh,
Juniper berries,
Canella alba, each four ounces;
French brandy, three gallons.

Steep the juniper berries and canella alba in the ſpirit for two days; then draw off three gallons.

This is an elegant ſpirit, though ſomewhat diſagreeable in the flavour. It is uſed as a powerful antiſcorbutic, though we ſhould very much doubt its efficacy in this reſpect.

AQUA VULNERARIA, ſeu AQUA CATAPULTARUM.

Pharm. Argent.

Arquebuſade Water.

Take of

Comfrey, leaves and root,
Sage,
Mugwort,

Buglofs, each four handfuls;
Betony,
Sanicle,
Ox-eye daify,
Common daify,
Greater figwort,
Plantane,
Agrimony,
Vervain,
Wormwood,
Fennel, each two handfuls;
St. John's wort,
Long birthwort,
Orpine,
Veronica,
Leffer centaury,
Milfoil,
Tobacco,
Moufe-ear,
Mint,
Hyffop, each one handful;
Wine, twenty-four pounds.

Having cut and bruifed the herbs, pour on them the wine, and let them ftand together in digeftion, in horfedung, or other equivalent heat, for three days: afterwards diftil in an alembic, with a moderate fire.

This celebrated water is chiefly againft external wounds and ulcers.

Class III. *Inflammables.*

FLORES SULPHURIS LOTI.

Lond.

Wafhed Flowers of Sulphur.

Take of
Flowers of fulphur, one pound;
Diftilled water, four pints

Boil the flowers of fulphur a little while in the diftilled water; then pour off this water, and wafh of the acid with cold water; laftly, dry the flowers

The wafhing of the fulphur is here directed for the purpofe of freeing it of any fuperfluous acid acquired in their preparation, and which is apt to irritate the bowels when ufed as a medicine.

KALI SULPHURATUM.

Lond.

Sulphurated Kali.

Take of
Flowers of fulphur, one ounce;
Kali, five ounces.

Mix the salt with the melted sulphur, by frequently stirring, until they unite in an uniform mass

In this preparation part of the sulphur is dissipated. It possesses, as a medicine, a fœtid smell and nauseous taste. It has been used in natural complaints in the form of syrup, though now exploded. It is also applied to cutaneous diseases, as herpes and psora, particularly in the form of ointment, and as a wash in cutaneous diseases. It forms a powerful antidote to mercurial poisons. It imparts a rich colour digested in alcohol.

OLEUM SULPHURATUM et PETROLEUM SULPHURATUM.

Lond.

Sulphurated Oil and Sulphurated Petroleum.

Take of

Flowers of sulphur, four ounces;
Olive oil, sixteen ounces.

Boil the flowers of brimstone, with the oil, in a pot slightly covered, until they be united.

In the same manner is made sulphurated petroleum.

These articles stand in place of the former sulphurated balsams, and the latter may be made by adding to the present preparation so much of any of the essential oils as gives it a sufficient impregnation. Though formerly much recommended in pectoral complaints, they are now entirely out of repute. The dose of the simple preparation is from 10 to 40 drops of the balsam; that of the compound less. Their external use to foul gleets and ulcerations form their most frequent mode of application.

SULPHUR PRECIPITATUM.

Lond.

Precipitated Sulphur.

Take of

Sulphurated kali, six ounces;
Distilled water, one pound and a half;
Vitriolic acid, diluted, as much as is sufficient.

Boil the sulphurated kali in the distilled water until it be dissolved. Filter the liquor through paper, to which add the vitriolic acid. Wash the precipitated powder by often pouring on water till it becomes insipid.

This preparation differs only in colour from the pure sulphur. From this colour its solution has been termed Lac Sulphuris.

Essential Oils.

Essential oils are only the product of odorous substances, and the quantity procured from different articles of this class cannot be previously determined from the apparent sensible qualities of the substance, and it is very much influenced by the soil and season in the same substance in a considerable degree. Thus dry soil and warm summers are the most favourable to procuring much of this product, and a moderate exsiccation of the substance will also facilitate its extrication.

In directing the distillation various circumstances require attention.

8. The first, is the quantity of water to be used, which must be here regulated by that of the material. Thus when the half of the cavity of the vessel is filled with the substance, as much water should be added as may occupy two thirds in height.

2. The next circumstance is the maceration of the substance, so that the fluid may penetrate every part of it; and in order to this taking place, the substance should be reduced, if wood, to coarse powder; if seeds, slightly bruised; and the time allotted for this operation, according to the texture of the substance, should be from a week or two to the same number of days.

3. The third circumstance is the addition of a slight ferment for a few days, with half their quantity of water.

4. The fourth is accommodating the instrument of distillation to the nature of the substance: thus, some substances do best with the common still; others require a large low head, having a rim or canal round it, to detain the oil in its first ascent.

5. In the management of the heat it should be raised quickly to keep the water strongly boiling, though the degree of heat is somewhat regulated by the nature of the substance, as some substances require less of it than others. In the former case the products are termed ponderous oils, in the latter, light oils; and to preserve their fragrance, the substance which gives out the latter, is not im-

merſed in the water of the ſtill, but ſuſpended immediately above it in a baſket.

6. The water which comes over in diſtillation ſhould be employed a ſecond time for the ſame purpoſe, and not that tainted with empyreuma which remains in the ſtill.

7. In diſtilling different oils cleanlineſs ſhould be obſerved, that no impregnation may be received from each other.

8. After diſtillation the oils ſhould be allowed to ſtand uncovered till they loſe their fiery odour, and then corked cloſe till uſed.

9. The qualities of eſſentials oils, when loſt, may be reſtored in the manner formerly pointed out, p. 126.

10. Eſſential oils agree only in two general circumſtances, their pungency and heat. They differ in their individual qualities, according to the nature of the ſubſtance from which they are taken.

11. The degree of their pungency and heat cannot alſo be judged of *a priori* from the ſenſible qualities of the ſubject from which they are taken.

12. In medicine eſſential oils are chiefly employed as correctors of diſagreeable medicines, particularly in their junction with reſinous purgatives, ſo as to make them ſit eaſy on the ſtomach.

13. Eſſential oils are exhibited by triture with ſugar, which renders them ſoluble in ſyrups and mucilaginous liquors, and in this form they are preſcribed.

Their general effects as medicines are, when pungent, powerful ſtimulants in palſy and chronic rheumatiſm, and in local affections of pain or ſwelling, where there is no active inflammation.

OLEUM ABSINTHII ESSENTIALE.

L. E.

Eſſential Oil of the Leaves of Wormwood.

This oil is recommended as a mild anodyne, diſſolved in ſpirit of wine in the proportion of a dram to the ounce, and ſeven or eight drops forming a doſe: externally, it is chiefly employed as a vermifuge.

OLEUM SEMINUM ANETHI ESSENTIALE.

Lond.

Essential Oil of Dill Seeds.

Is useful in flatulence and cholic from one to four drops.

OLEUM SEMINUM ANISI ESSENTIALE.

L. E.

Essential Oil of Anniseed.

It is superior to the former for the same purpose, and may be taken in fifteen or twenty drops.

OLEUM SEMINUM CARUI ESSENTIALE.

L. E.

Essential Oil of Caraway Seeds.

Is a powerful carminative and diuretic. Three drops are a dose.

OLEUM CARYOPHYLLORUM AROMATICORUM ESSENTIALE.

L. E.

Essential Oil of Cloves:

The genuine oil of cloves is mild, and may be safely taken diluted to ten or twelve drops, as a stomachic and stimulant.

OLEUM FLORUM CHAMÆMELI ESSENTIALE.

Lond.

Essential Oil of Chamomile Flowers.

Is given in nervous cases in a few drops, and is also used as a vermifuge.

OLEUM CINNAMOMI.

L E.

Oil of Cinnamon.

Is a powerful nervous medicine and restorative, in doses of two or three drops.

OLEUM SEMINUM CYMINI ESSENTIALE.

Lond.

Essential Oil of Cummin Seeds.

This is employed in nervous cases in a dose of two or three drops, being reckoned also diuretic.

OLEUM SEMINUM FÆNICULI ESSENTIALE.

Edinb.

Essential Oil of Fennel.

It is a useful carminative, given in doses from two or three to twelve drops.

OLEUM BACCARUM JUNIPERI ESSENTIALE.
L. E.
Essential Oil of Juniper Berries.

Is more stimulant than the former, but given in the same cases.

OLEUM FLORUM LAVENDULÆ ESSENTIALE.
L. E.
Essential Oil of Lavender Flowers.

Is a medicine of great worth externally and internally in all affections of the nervous system. The dose from one drop to five or six.

ESSENTIA LIMONUM.
[L.]
OLEUM CORTICUM.
[L.]
Essence of Lemons, or the Essential Oil of Lemon Peel.

It is a pleasant cordial and perfume, and used in the preparation of other medicines.

OLEUM MAJORANÆ ESSENTIALE.
Lond.
Essential Oil of Marjoram Leaves.

This oil is supposed to possess a specific action in uterine diseases attended with relaxation, and it is given in a dose of one or two drops.

OLEUM MENTHÆ ESSENTIALE.
L. E.
Essential Oil of the Leaves of common Mint.

Is a useful stomachic medicine in weakness of the organ, in a dose of two or three drops.

OLEUM MENTHÆ PIPERITIDIS ESSENTIALE.
L. E.
Essential Oils of the Leaves of Peppermint.

This oil is the most useful of all carminatives, in the dose of a drop or two.

OLEUM NUCIS MOSCHATÆ ESSENTIALE.
L. E.
Essential Oil of Nutmegs.

Possesses all the flavor and aromatic virtues of the spice for which it is used.

OLEUM ORIGANI ESSENTIALE.
L. E.
Essential Oil of the Leaves of Origanum

This oil is chiefly as a caustic, and for tooth-ach.

OLEUM ESSENTIALE PIPERIS JAMAICENSIS.
Edinb.
Essential Oil of Jamaica Pepper.

This oil is cheaper than that of nutmegs, and used for the same purpose.

OLEUM PULEGII ESSENTIALE.
Edinb.
Essential Oil of Penny-Royal.

This oil is used in hysteric cases, in a dose of one to five drops.

OLEUM RORISMARINI ESSENTIALE.
L. E.
Essential Oil of Rosemary.

It is very fragrant, and recommended in nervous complaints in the dose of a few drops.

OLEUM LIGNII ESSENTIALE.
L. E.
Essential Oil of Rhodium.

This is used principally, from its odoriferous quality, as a perfume.

OLEUM RUTÆ ESSENTIALE.
L. E.
Essential Oil of Rue Leaves.

Is a powerful anti hysteric and emmenagogue.

OLEUM SABINÆ ESSENTIALE.
L. E.
Essential Oil of Savin Leaves.

Possesses the same qualities as the former, in a dose of two or three drops.

OLEUM SASSAFRASS ESSENTIALE.
L. E.
Essential Oil of Sassafras

Is a powerful sudorific and alterative, given from one drop to eight for a dose.

OLEUM TEREBINTHINÆ.
Lond. Edin.
Oil of Turpentine.

This is a hot ſtimulating medicine, and given as a ſudorific and diuretic, in two or three drops. In larger doſes it excites perſpiration, and is given with honey in ſciatica; externally, it is applied in chronic rheumatiſm, ſwellings of various kinds, and paſſive hemorrhages.

CLASS IV. *Salts.*

ACIDUM VITRIOLICUM DILUTUM.
Lond.
Diluted Vitriolic Acid.

Take of
Vitriolic acid, one ounce by weight;
Diſtilled water, eight ounces by weight.
Mix them by degrees.

ACIDUM VITRIOLICUM DILUTUM, *vulgo* SPIRITUS VITRIOLI TENUIS.
Edin.
Diluted Vitriolic Acid, commonly called *Weak Spirit of Vitriol.*

Take of
Vitriolic acid, one part;
Water, ſeven parts.
Mix them.

ACIDUM NITROSUM.
Lond.
Nitrous acid.

Take of
Purified nitre, ſixty ounces;
Vitriolic acid, by weight, twenty-nine ounces.
Mix and diſtil.
The ſpecific gravity of this acid is to that of diſtilled water as 1,550 to 1,000.

ACIDUM NITROSUM, *vulgo* SPIRITUS NITRI.
Edin.
Nitrous Acid, commonly called *Spirit of Nitre.*

Take of
Pureſt nitre, bruiſed, two pounds;
Vitriolic acid, one pound.
Having put the nitre into a glaſs retort, pour on it the acid; then diſtil in a ſand-heat, gradually increaſing the fire till the ſand-pot becomes of a dull red colour.

The ſpecific gravity of it to that of water ought to be as 1,550 to 1,000.

It has been given, diluted with any convenient vehicle, as a diuretic, in doſes of from ten to fifty drops.

ACIDUM NITROSUM DILUTUM.
Lond. Edinb.
Diluted Nitrous Acid.

Take of
Nitrous acid,
Diſtilled water, each equal weights.
Mix them, taking care to avoid the noxious vapours.

ACIDUM MURIATICUM.
Lond.
Muriatic Acid.

Take of
Dry ſea-ſalt, ten pounds;
Vitriolic acid, by weight ſix pounds;
Water, by weight, five pounds.
Add the vitriolic acid, firſt mixed by degrees with the water, to the ſalt; then diſtil.
The ſpecific gravity of this acid is to that of diſtilled water as 1,170 to 1,000.

ACIDUM MURIATICUM, *vulgo* SPIRITUS SALINIS MARINI.
Edin.
Muriatic Acid, commonly called *Spirit of Sea-Salt.*

Take of
Sea-ſalt, two pounds;
Vitriolic acid,
Water, each one pound.
Let the ſalt be firſt put into a pot, and brought to a red heat, that the oily impurities may be conſumed; then put it into the retort; next mix the acid with the water, and when the mixture has cooled, pour it upon the ſalt. Laſtly, diſtil in a ſand bath, with a middling heat, as long as any acid comes over.
The ſpecific gravity of this acid is to that of water as 1,170 to 1,000.

It is uſed chiefly as a menſtruum for the making of other preparations; ſometimes, likewiſe, it is given, properly diluted, as an antiphlogiſtic, aperient, and diuretic, in doſes of from ten to ſixty or ſeventy drops.

ACETUM DISTILLATUM.

Lond.

Distilled Vinegar.

Take of

Vinegar five pints.

Distil [illegible] fire, in glass vessels, so long as the drops fall free from empyreuma.

Edin.

Let eight pounds of vinegar be distilled in glass vessels with a gentle heat. Let the two first pounds that come over be thrown away, as containing too much water; let the four pounds next following be reserved as the distilled vinegar. What remains is a still stronger acid, but being too much burnt is unfit for use.

Their principal difference from the mineral acids consists in their being milder, less stimulating, less disposed to affect the kidneys and promote the urinary secretions, or to coagulate the animal juices. The matter left after the distillation in glass vessels, though not used internally, would doubtless prove a serviceable detergent.

ACETUM CONCENTRATUM.

Suec.

Concentrated Vinegar.

Let white wine vinegar be frozen in a wooden vessel in cold winter weather; and let the fluid separated from the ice be preserved for use. It may be considered as sufficiently strong, if one drachm of it be capable of saturating a scruple of the fixed vegetable alkali.

ACIDUM ACETOSUM.

Lond.

Acetous Acid.

Take of

Verdigris, in coarse powder, two pounds.

Dry it perfectly by means of a water-bath saturated with sea salt; then [illegible] it in a sand-bath, and distil the liquor a second time. [illegible] specific gravity is to that of distilled water as 1,050 to 1,000.

ACIDUM TARTARI CRYSTALLISATUM.

Suec.

Crystallized Acid of Tartar.

Take of

Prepared chalk, frequently washed with warm water, two pounds;

Spring water, thirty-two pounds.

A[illegible] slight boiling, by degrees add of cream of tartar seven pounds, [illegible] as much as is sufficient for saturation. Removing the [illegible]

from the fire, let it ſtand for half an hour, then cautiouſly pour off the clear liquor into a glaſs veſſel. Waſh the reſiduum or tartareous ſelenites by pouring water on it three or four times. To this reſiduum afterwards add of weak vitriolic acid (conſiſting of one part of ſtrong acid, and eight of water,) fifteen pounds: let it be digeſted for a day, frequently ſtirring it with a wooden ſpatula. After this pour the acid liquor into a glaſs veſſel; but with the reſiduum mix ſixteen pounds of boiling water: ſtrain it through paper, and again pour water on the reſiduum till it become inſipid. Let the acid liquors mixed together in a glaſs veſſel, be boiled to the conſiſtence of a thin ſyrup; which being ſtrained, muſt be put into earthen veſſels, and evaporated in a ſand-heat, till the acid concretes into ſlender cryſtals; obſerving to break, every two hours, the ſaline pellicle formed on the ſurface of the liquor during the evaporation. The cryſtals being at length fully dried, muſt be kept in a well ſtopped glaſs phial.

If before cryſtallization a little of the inſpiſſated acid liquor be diluted with four times its quantity of pure water, and a few drops of acetated lead be put into it, a white ſediment will immediately be depoſited. If a few drops of the diluted nitrous acid be then added, the mixture will become limpid if the tartareous liquor be pure and entirely free from the vitriolic acid; but if it be not, it will remain white. This fault, however, may be corrected, if the acid of tartar be diluted with ſix pounds of water, and a few ounces of the tartareous ſelenite be added to it. After this it may be digeſted, ſtrained, and cryſtallized.

ACIDUM TARTARI DISTILLATUM.

Diſtilled Acid of Tartar.

Let pounded crude tartar be put into a tubulated earthen or iron retort till it fills about two thirds of it, and let diſtillation be performed by gradually increaſing the heat. Into the recipient, which ſhould be very large, an acid liquor will paſs over together with the oil; which being ſeparated from the oil, muſt again be diſtilled from a glaſs retort.

If the reſiduum contained in the earthen or iron retort be diluted with water, ſtrained through paper and boiled to dryneſs, it gives what is called the alkali of tartar. If this do not appear white, it may be made ſo by burning, ſolution, ſtraining, and evaporation.

AQUA AERIS FIXI.

R. ſ.

Aerated Water.

Let ſpring water be ſaturated with the fixed air, or aerial acid, ariſing from a ſolution of chalk in vitriolic acid, or in any ſimilar acid.

Water may be alfo impregnated by the fixed air rifing from fermenting liquors.

Water properly impregnated with the aerial acid has an agreeable, acidulous tafte. It is often employed with great advantage in the way of common drink, by thofe who are fubject to ftomach complaints, and by calculous patients. But, befides this, it furnifhes an excellent vehicle for the exhibition of many other medicines.

AQUA ALKALINA AERATA.

Aerated Alkaline Water.

Let a folution of two ounces of vegetable alkali, in a gallon of water, be faturated with fixed air.

This aerated alkaline water has been found very ferviceable in calculous and gouty cafes.

FLORES BENZOES.

Lond.

Flowers of Benzoine.

Take of

Benzoine, in powder, one pound.

Put it into an earthen pot, placed in fand; and, with a flow fire, fublime the flowers into a paper cone fitted to the pot.

If the flowers be of a yellow colour, mix them with white clay, and fublime them a fecond time.

ACIDUM BENZOINICUM, *vulgo* FLORES BENZOINI.

Edin.

Benzoinic Acid, commonly called *Flowers of Benzoin.*

Put any quantity of powdered benzoine into an earthern pot, to which, after fitting it with a large conical paper cap, apply a gentle heat, that the flowers may fublime. If the flowers be impregnated with oil, let them be purified by folution in warm water and cryftallization.

SAL BENZOES.

Suec.

Salt of Benzoine.

Take of

Benzoine, in fine powder,

Quicklime powdered, each half a pound;

Water, four pounds.

Boil them gently for a quarter of an hour, and filter the liquor, while warm, through paper. Add to the refiduum four pounds more of water. Boil and filter this liquor as the former. Mix thefe and boil

them in a tin veſſel down to two pounds. When cold, pour it into a glaſs veſſel, and drop into it ſome muriatic acid as long as any precipitate is formed. After ſtanding a while, pour off the clear liquor; waſh the precipitate with cold water, and dry it on filtering paper.

Theſe flowers, when made in perfection, have an agreeable taſte and fragrant ſmell. They totally diſſolve in ſpirit of wine; and likewiſe, by the aſſiſtance of heat, in water. By the mediation of ſugar they remain ſuſpended in cold water, and thus form an elegant balſamic ſyrup. Some have held them in great eſteem as pectoral and ſudorific, in the doſe of half a ſcruple or more: but at preſent they are rarely uſed, on account of the offenſive oil with which, as uſually prepared, they are tainted.

They enter the compoſition of the paregoric elixir, or *tinctura opii camphorata*, as it is now called.

LIXIVA E TARTARO, *vulgo* SAL TARTARI.
Edin.

Lixive of Tartar, commonly called *Salt of Tartar*.

Take of

Tartar, what quantity you pleaſe.

Roll it up in a piece of moiſt bibulous paper, or put it into a crucible, and burn it to a coal; next, having beat this coal, calcine it in an open crucible with a moderate heat, taking care that it do not ſm it, and continue the calcination till the coal becomes of a white, or at leaſt of an aſh colour; then diſſolve it in warm water; ſtrain the liquor through a cloth, and evaporate it in a clean iron veſſel; diligently ſtirring it towards the end of the proceſs with an iron ſpatula, to prevent it from ſticking to the bottom of the veſſel. A very white ſalt will remain, which is to be left a little longer on the fire, till the bottom of the veſſel becomes almoſt red. Laſtly, when the ſalt is grown cold, let it be put up in glaſs veſſels well ſtopped.

KALI PRÆPARATUM.
Lond.

Prepared Kali.

Take of

Pot-aſh, two pounds;

Boiling diſtilled water, three pints.

Diſſolve and filter through paper; evaporate the liquor till a pellicle appears on the ſurface; then ſet it aſide for 12 hours that the neutral ſalts may cryſtallize; after which pour out the liquor, and

boil away the whole of the water, conſtantly ſtirring, leſt any ſalt ſhould adhere to the pot

In like manner is purified impure kali from the aſhes of any kind of vegetable.

The ſame ſalt may be prepared from tartar burnt till it becomes of an aſh colour.

LIXIVA PURIFICATA, *vulgo* SAL ALKALINUS FIXUS VEGETABILIS PURIFICATUS.

Edin.

Purified Lixive, commonly called *Purified Fixed Vegetable Alkaline Salt.*

Let the fixed alkaline ſalt, called in Engliſh pearl-aſhes, be put into a crucible, and brought to a ſomewhat red heat, that the oily impurities, if there be any, may be conſumed: then having powdered it, agitate it with an equal weight of water, that they may be well mixed. After the fæces have ſubſided, pour the ley into a very clean iron pot, and boil to dryneſs, ſtirring the ſalt towards the end of the proceſs, to prevent its ſticking to the veſſel.

If this ſalt has been rightly purified, though it be very dry it may be diſſolved into a liquor void of colour or ſmell, by rubbing it with an equal weight of water.

The purified vegetable alkali is frequently employed in medicine, in conjunction with other articles: particularly for the formation of ſaline neutral draughts and mixtures: but it is uſed alſo by itſelf in doſes of from three or four grains to fifteen or twenty; and it frequently operates as a powerful diuretic, particularly when aided by proper dilution and a warm regimen.

AQUA KALI PRÆPARATI.

Lond.

Water of Prepared Kali.

Take of

Prepared kali, one pound.

Set it by in a moiſt place till it be diſſolved, and then ſtrain it

AQUA KALI PURI.

Lond.

Water of Pure Kali.

Take of

Prepared kali, four pounds;
Quick lime, ſix pounds;
Diſtilled water, four gallons.

Put four pints of water to the lime, and let them ſtand together for an hour; after which, add the kali and the reſt of the water; then boil for a quarter of an hour; ſuffer the liquor to cool, and ſtrain it. A pint of this liquor ought to weigh ſixteen ounces. If the liquor efferveſces with any acid, add more lime, and boil the liquor for five minutes, after which ſtrain it.

AQUA LIXIVIA CAUSTICA, *vulgo* LIXIVIUM CAUSTICUM.

Edin.

Cauſtic Ley.

Take of

Freſh burnt quicklime, eight ounces;

Purified lixive, ſix ounces.

Throw the quicklime into an iron or earthen veſſel, with twenty-eight ounces of warm water. The ebullition and extinction of the lime being perfectly finiſhed, inſtantly add the alkaline ſalt; and having thoroughly mixed them, cover the veſſel till it be cool. Stir the cooled matter, and pour out the whole into a glaſs funnel, whoſe throat muſt be ſtopped up with a piece of clean rag. Let the upper mouth of the funnel be covered, while the tube of it is inſerted into a glaſs veſſel, ſo that the ley may gradually drop through the rag into that veſſel. When it firſt gives over dropping, pour into the funnel ſome ounces of water, but cautiouſly; ſo that the water may ſwim above the matter. The ley will again begin to drop, and the effuſion of water is to be repeated in the ſame manner, until three pounds have dropped, which takes up the ſpace of two or three days; then agitating the ſuperior and inferior parts of the ley together, mix them, and put them up in a well ſtopt phial.

If the ley be rightly prepared, it will be void of colour or ſmell; nor will it raiſe an efferveſcence with acids, except, perhaps, a very ſlight one. Colour and odour denote the ſalt not ſufficiently calcined; and efferveſcence, that the quicklime has not been good.

The cauſtic ley, under various pompous names, has been much uſed as a lithontriptic; but its fame is now beginning to decline. In acidities in the ſtomach, attended with much flatulence and laxity, the cauſtic ley is better adapted than mild alkalies; as in its union with the acid matter it does not ſeparate air. When covered with mucilaginous matters, it may be ſafely taken into the ſtomach; and by ſtimulating it, coincides with the other intentions of cure. It has been employed with advantage in dyſpeptic caſes.

KALI PURUM.

Lond.

Pure Kali.

Take of

Water of pure kali, one gallon.

Evaporate it to dryness; after which let the salt melt on the fire, and pour it out.

CAUSTICUM COMMUNE ACERRIMUM.

Edin.

The strongest Common Caustic.

Take of

Caustic ley, what quantity you please.

Evaporate it in a very clean iron vessel on a gentle fire, till, on the ebullition ceasing, the saline matter gently flows like oil, which happens before the vessel becomes red. Pour out the caustic, thus liquified, on a smooth iron plate: let it be divided into small pieces before it hardens, which are to be kept in a well stopt phial.

The caustic prepared in this way has an inconvenience of being apt to liquefy too much on the part to which it is applied, so that it is not easily confined within the limits in which it is intended to operate; and indeed the suddenness of its action depends on this disposition to liquefy.

CALX CUM KALI PURO.

Lond.

Lime with Pure Kali.

Take of

Quicklime, five pounds and four ounces;

Water of pure kali, sixteen pounds by weight.

Boil away the water of pure kali to a fourth part; then sprinkle in the lime, reduced to powder by the affusion of water. Keep it in a vessel close stopped.

CAUSTICUM COMMUNE MITIUS.

Edin.

The milder Common Caustic.

Take of

Caustic ley, what quantity you please.

Evaporate it in an iron vessel till one-third remains; then mix with it as much new-slaked quicklime as will bring it to the consistence of pretty solid pap, which is to be kept in a vessel closely stopt.

NATRON PRÆPARATUM.
Lond.
Prepared Natron.

Take of
Barilla, powdered, two pounds;
Distilled water, one gallon.

Boil the barilla in four pints of water for half an hour, and strain. Boil the residuum with the rest of the water, and strain. Evaporate the mixed liquors to two pints, and set them by for eight days; strain this liquor again; and after due boiling, set it aside to crystallize. Dissolve the crystals in distilled water; strain the solution, boil, and set it aside to crystallize.

SODA PURIFICATA, *vulgo* SAL ALKALINUS FIXUS FOSSILIS PURIFICATUS.
Edin.
Purified Soda, commonly called *Purified Fixed Fossil Alkaline Salt.*

Take of
Ashes of Spanish kali, or barilla, as much as you please.

Bruise them; then boil in water till all the salt be dissolved. Strain this through paper, and evaporate it in an iron vessel, so that after the liquor has cooled the salt may concrete into crystals.

The fossil alkali is not only a constituent of different neutrals, but it is also sometimes employed as a medicine by itself. And in its purified state it has been by some reckoned useful in affections of the scrophulous kind.

AMMONIA PRÆPARATA.
Lond.
Prepared Ammonia.

Take of
Sal ammoniac, powdered, one pound;
Prepared chalk, two pounds.

Mix and sublime.

AMMONIA PRÆPARATA, *vulgo* SAL AMMONIACUS VOLATILIS.
Edin.
Prepared Ammonia, commonly called *Volatile Sal Ammoniac.*

Take of
Sal ammoniac, one pound;
Chalk, very pure and dry, two pounds.

Mix them well, and sublime from a retort into a refrigerated receiver.

AQUA AMMONIÆ.
Lond.
Water of Ammonia.

Take of
Sal ammoniac, one pound;
Pot-ash, one pound and a half;
Water, four pints.
Draw off two pints by distillation, with a slow fire.

AQUA AMMONIÆ, *vulgo* SPIRITUS SALIS AMMONIACI.
Edin.
Water of Ammonia, commonly called *Spirit of Sal Ammoniac.*

Take of
Sal ammoniac,
Purified lixive, of each sixteen ounces;
Water, two pounds.
Having mixed the salts, and put them into a glass retort, pour in the water; then distil to dryness with a sand-bath, gradually raising the heat.

AQUA AMMONIÆ PURÆ.
Lond.
Water of Pure Ammonia.

Take of
Sal ammoniac, one pound;
Quicklime, two pounds;
Water, one gallon.
Add to the lime two pints of the water. Let them stand together an hour; then add the sal ammoniac and the other six pints of water boiling, and immediately cover the vessel. Pour out the liquor when cold, and distil off, with a slow fire, one pint.

AQUA AMMONIÆ CAUSTICÆ, *vulgo* SPIRITUS SALIS AMMONIACI CUM CALCE VIVE.
Edin.
Water of Caustic Ammonia, commonly called *Spirit of Sal Ammoniac with Quicklime.*

Take of
Quicklime, fresh burnt, two pounds;
Water, one pound.
Having put the water into an iron or stone-ware vessel, add the quicklime, previously beat; cover the vessel for twenty-four hours: when the lime has fallen into a fine powder, put it into the retort; then add sixteen ounces of sal ammoniac, dissolved in five pounds of water; and, shutting the mouth of the retort, mix them together by agi-

tation. Laſtly, diſtil into a refrigerated receiver with a very gentle heat, (ſo that the operator's hand can eaſily bear the heat of the retort) till twenty ounces of liquor are drawn off. In this diſtillation the veſſels are to be ſo luted as to effectually reſtrain the vapours, which are very penetrating.

LIQUOR VOLATILIS, SAL, ET OLEUM CORNU CERVI.

Lond.

The Volatile Liquor, Salt, and Oil, of Hartſhorn.

Take of

Hartſhorn, ten pounds.

Diſtil with a fire gradually increaſed. A volatile liquor, ſalt, and oil will aſcend.

The oil and ſalt being ſeparated, diſtil the liquor three times.

To the ſalt add an equal weight of prepared chalk, and ſublime thrice, or till it become white.

The ſame volatile liquor, ſalt, and oil, may be obtained from any parts (except the fat) of all kinds of animals.

KALI VITRIOLATUM.

Lond.

Vitriolated Kali.

Take of

The ſalt which remains after the diſtillation of the nitrous acid, two pounds.

Diſtilled water, two gallons.

Burn out the ſuperfluous acid, with a ſtrong fire, in an open veſſel; then boil it a little while in the water; ſtrain, and ſet the liquor aſide to cryſtallize.

LIXIVA VITRIOLATA, *vulgo* TARTARUM VITRIOLATUM.

Edin.

Vitriolated Lixive, commonly called *Vitriolated Tartar.*

Take of

Vitriolated acid, diluted with ſix times its weight of water, as much as you pleaſe.

Put it into a capacious glaſs veſſel, and gradually drop into it, of purified lixive, diluted with ſix times its weight of water, as much as is ſufficient thoroughly to neutralize the acid. The effervеſcence being finiſhed, ſtrain the liquor through paper: and after proper evaporation, ſet it aſide to cryſtallize.

Vitriolated tartar, in ſmall doſes, as a ſcruple or half a drachm, is an uſeful aperient; in large ones, as four or five drachms, a mild cathartic, which does not paſs off

ſo haſtily as the *magneſia vitriolata*, or *ſoda vitriolata*, and ſeems to poſſeſs a more extended action.

LIXIVIA VITRIOLATA SULPHUREA, *vulgo* SAL POLYCHRESTUS.

Edin.

Sulphureous Vitriolated Lixive, commonly called *Salt of many Virtues.*

Take of
- Nitre in powder,
- Flowers of ſulphur, of each equal parts.

Mix them well together, and inject the mixture, by little and little at a time, into a red-hot crucible: the deflagration being over, let the ſalt cool, after which it is to be put up in a glaſs veſſel well ſtopped. The ſalt may be purified by diſſolving it in warm water, filtering the ſolution, and cryſtallizing it again.

NATRON VITRIOLATUM.

Lond.

Vitriolated Natron.

Take of
- The ſalt which remains after the diſtillation of the muriatic acid, two pounds;
- Diſtilled water, two pints and an half.

Burn out the ſuperfluous acid with a ſtrong fire, in an open veſſel; then boil it for a little in the water; ſtrain the ſolution, and ſet it aſide to cryſtallize.

SODA VITRIOLATA, *vulgo* SAL GLAUBERI.

Edin.

Vitriolated Soda, commonly called *Glauber's Salts.*

Diſſolve in warm water the maſs which remains after the diſtillation of the muriatic acid; filter the ſolution, and cryſtallize the ſalt.

NITRUM PURIFICATUM.

Lond.

Purified Nitre.

Take of
- Nitre, two pounds;
- Diſtilled water, four pints.

Boil the nitre in the water till it be diſſolved; ſtrain the ſolution, and ſet it aſide to cryſtallize.

KALI ACETUM.

Lond.

Acetated Kali.

Take of
- Kali, one pound.

Boil it, with a flow fire, in four or five times its quantity of diftilled vinegar: the effervefcence ceafing, add, at different times, more diftilled vinegar, until the laft vinegar being nearly evaporated, the addition of frefh will excite no effervefcence, which will happen when about twenty pounds of diftilled vinegar are confumed: afterwards let it be dried flowly. An impure falt will be left, which melt for a little while with a flow fire; then let it be diffolved in water, and filtered through paper.

If the fufion has been rightly performed, the ftrained liquor will be colourlefs; if otherwife, of a brown colour.

Laftly, evaporate this liquor with a flow fire, in a very fhallow glafs veffel; frequently ftirring the mafs, that the falt may be more completely dried, which fhould be kept in a veffel clofe ftopped.

The falt ought to be very white, and diffolve wholly, both in water and fpirit of wine, without leaving any feces If the falt, although white, fhould depofit any feces in fpirit of wine, that folution in the fpirit fhould be filtered through paper, and the falt again dried.

LIXIVA ACETATA, *vulgo* TARTARUM REGENERATUM.

Edin.

Acetated Lixive, commonly called *Regenerated Tartar*.

Take of

Purified lixive, one pound.

Boil it with a very gentle heat in four or five times its quantity of diftilled vinegar; add more diftilled vinegar, at different times, till on the watery part of the former quantity being nearly diffipated by evaporation, the new addition of vinegar ceafes to raife any effervefcence. This happens, when about twenty pounds of diftilled vinegar has been confumed. The impure falt remaining after the exficcation, is to be melted with a gentle heat, and kept fluid only for a fhort time; then diffolve it in water, and ftrain through paper. If the liquefaction has been properly performed, the ftrained liquor will be limpid; but if otherwife, of a brown colour.

Evaporate this liquor with a very gentle heat in a fhallow glafs veffel, occafionally ftirring the falt as it becomes dry, that its moifture may fooner be diffipated. Then put it up into a veffel very clofely ftopt, to prevent it from liquefying in the air.

Another Procefs.

Diffolve a pound of falt of tartar in a fufficient quantity of cold water; filter the folution, and add by degrees as much diftilled vinegar as will faturate it, or a little more. Set the liquor to evaporate in a ftone-ware veffel in a gentle heat, not fo ftrong as to make it boil. When a pellicle appears on the furface, the reft of the procefs muft be finifhed in a water-bath. The liquor acquires, by degrees, an oily confiftence and a pretty deep brown

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colour; but the pellicle or ſcum on the top looks whitiſh, and when taken off and cooled, appears a congeries of little brilliant ſilver-like plates. The matter is to be kept conſtantly ſtirring, till it be wholly changed into this white flaky ſubſtance; the complete drying of which is moſt conveniently effected in a warm oven.

The *lixiva acetata*, which way ſoever prepared, provided it be properly made, is a medicine of great efficacy, and may be ſo doſed and managed as to prove either mildly cathartic, or powerfully diuretic: few of the ſaline deobſtruents come up to it in virtue. The doſe is from half a ſcruple to a drachm or two.

AQUA AMMONIÆ ACETATÆ.
Lond
Water of Acetated Ammonia.

Take of
Ammonia, by weight, two ounces;
Diſtilled vinegar, four pints; or as much as is ſufficient to ſaturate the ammonia.
Mix.

AQUA AMMONIÆ ACETATÆ, *vulgo* SPIRITUS MINDERERI.
Edin.
Water of Acetated Ammonia, commonly called *Spirit of Mindererus.*

Take any quantity of prepared ammonia, and gradually pour as much diſtilled vinegar on it as is ſufficient to ſaturate it completely.

This is an excellent aperient ſaline liquor. Taken warm in bed, it generally proves a powerful diaphoretic or ſudorific; and as it operates without heat, it has place in febrile and inflammatory diſorders, where medicines of the warm kind, if they fail of procuring ſweat, aggravate the diſtemper. Its action may likewiſe be determined to the kidneys, by walking about in a cool air. The common doſe is half an ounce, either by itſelf, or along with other medicines adapted to the intention.

KALI TARTARISATUM.
Lond.
Tartariſed Kali.

Take of
Prepared kali, one pound;
Cryſtals of tartar, three pounds;
Diſtilled water, boiling, one gallon.

To the kali, dissolved in the water, throw in gradually the crystals of tartar powdered; filter the liquor, when cold, through paper; and after due evaporation, set it apart to crystallize.

LIXIVA TARTARISATA, *vulgo* TARTARUM SOLUBILE.

Edin.

Tartarised Lixive, commonly called *Soluble Tartar*.

Take of
- Purified lixive, one pound;
- Water, fifteen pounds.

To the salt dissolved in the boiling-water gradually add crystals of tartar in fine powder, as long as any effervescence rises, which generally ceases before three times the weight of the alkaline salt hath been added; then strain the cooled liquor through paper, and after due evaporation set it aside to crystallize.

In doses of a scruple, half a drachm, or a drachm, this salt is a mild cooling aperient: two or three drachms commonly loosen the belly; and an ounce proves pretty strongly purgative. It has been particularly recommended as a purgative for maniacal and melancholic patients.

NATRON TARTARISATUM.

Lond.

Tartarised Natron.

Take of
- Natron, twenty ounces;
- Crystals of tartar, powdered, two pounds;
- Distilled water, boiling, ten pints.

Dissolve the natron in the water, and gradually add the crystals of tartar; filter the liquor through paper; evaporate, and set it aside to crystallize.

SODA TARTARISATA, *vulgo* SAL RUPELLENSIS.

Edin.

Tartarised Soda, commonly called *Rochel Salt*.

The *Sal Rupellensis* may be prepared from purified soda and crystals of tartar, in the same manner as directed for the *Lixiva tartarisata*.

It is considerably less purgative than the preceding preparation, but is equally decompounded by acids. It appears to be a very elegant salt, and is in great esteem in this country.

SODA PHOSPHORATA.
Edin.
Phosphorated Soda.

Take of
Bones burnt to white ashes and powdered, ten pounds;
Vitriolic acid, six pounds;
Water, nine pounds.

Mix the powder and acid together in an earthen vessel; then add the water, and stir the whole so as to mix it thoroughly. Place the vessel in a vapour bath, and digest for three days; after which dilute the mass with nine pounds more of boiling water, and strain the liquor through a strong linen cloth, adding at the end some more warm water, that all the acidity may be well washed out. Set by the strained liquor that the impurities may subside, and decant the clear solution. Evaporate it till only nine pounds remain, and let it stand till the impurities subside. This second liquor poured from the impurities must be evaporated again till seven pounds remain, which must be set a third time to deposit its impurities, after which it is to be filtered: this filtered liquor contains the phosphoric acid sufficiently pure, to which, heated a little, add purified soda dissolved in warm water until the effervescence ceases. Filter the neutralised liquor, and set it aside to crystallize. The liquor that remains after the crystals are taken out must be farther neutralized by the addition of soda, if necessary, evaporated and set aside to crystallize again; and this must be repeated as long as any crystals can be obtained.

It is possessed of the same medical qualities as Glauber's and the Rochelle salt, being an excellent purge in the quantity of an ounce or ten drachms.

ALUMINIS PURIFICATIO.
Lond.
Purification of Alum.

Take of
Alum, one pound;
Chalk, one drachm;
Distilled water, one pint.

Boil them a little, strain, and set the liquor aside to crystallize.

ALUMEN USTUM.
Lond. Edinb.
Burnt Alum.

Take of
Alum, half a pound.

Burn it in an earthen vessel until it ceases to bubble.

In this ſtate it is ſo acrid as to be frequently employed as an eſcharotic.

SAL *ſive* SACCHARUM LACTIS.

Suec.

Take of milky whey, prepared by rennet, any quantity; let it be boiled over a moderate fire to the conſiſtence of a ſyrup; then put it in a cold place, that cryſtals may be formed. Let the fluid which remains be again managed in the ſame manner, and let the cryſtals formed be waſhed with cold water.

This preparation has been greatly celebrated in diſorders of the breaſt, but it is far from anſwering what has been expected from it.

SAL ACETOSELLÆ.

Suec.

Salt of Sorrel.

Take any quantity of the expreſſed juice of the leaves of the wood ſorrel; let it boil gently, that the feculent matter may be ſeparated; then ſtrain it till it be clear, and after this boil it on a moderate fire to the conſiſtence of a ſyrup. Put it into long necked glaſs veſſels, and place it in a cold ſituation that it may cryſtallize. Let theſe cryſtals be diſſolved in water, and again formed into purer ones.

The virtues of the eſſential ſalts have not been ſufficiently determined from experience. Thus much, however, is certain, that they do not, as has been ſuppoſed, poſſeſs the virtues of the ſubjects entire, excepting only the acids and ſweets.

SAL ACIDUM BORACIS.

Suec.

Acid Salt of Borax.

Take of
Borax, an ounce and a half;
Warm ſpring water, one pound.

Mix them in a glaſs veſſel, that the borax may be diſſolved; then pour into it three drachms of the concentrated vitriolic acid; evaporate the liquor till a pellicle appears upon it; after this let it remain at reſt till the cryſtals be formed. Let them be waſhed with cold water and kept for uſe.

This ſalt has been ſuppoſed to be a mild anodyne, to diminiſh febrile heat, to prevent or remove delirium; and to allay,

at leaſt for ſome time, ſpaſmodical affections, particularly thoſe which are the attendants of hyponchondriaſis and hyſteria. It may be given in doſes of from two to twenty grains.

SAL AMMONIACUM DEPURATUM.
Suec.

Diſſolve ſal ammoniac in ſpring water; ſtrain the liquor through paper; evaporate it to dryneſs in a glaſs veſſel, by means of a moderate fire.

CLASS V. *Earths.*

MAGNESIA ALBA.
Lond.
White Magneſia.

Take of
Vitriolated magneſia,
Kali, each two pounds;
Diſtilled water, boiling, twenty pints.
Diſſolve the vitriolated magneſia and the kali ſeparately in ten pints of water, and filter each through paper; then mix them. Boil the liquor a little while, and ſtrain it while hot through linen, upon which the magneſia will remain; then waſh away, by repeated affuſions of diſtilled water, the vitriolated kali.

MAGNESIA ALBA.
Edin.
White Magneſia.

Take of
Vitriolated magneſia,
Purified lixive, equal weights.
Diſſolve them ſeparately in double their quantity of warm water, and let the liquors be ſtrained or otherwiſe freed from the feces; then mix them, and inſtantly add eight times their quantity of warm water. Let the liquor boil a little, ſtirring it very well at the ſame time; then let it reſt till the heat be ſomewhat diminiſhed; after which ſtrain it through a cloth: the magneſia will remain upon the cloth, and is to be waſhed with pure water till it be altogether void of ſaline taſte.

A large doſe of magneſia, if the ſtomach contain no acid to diſſolve it, neither purges nor produces any ſenſible effect. A moderate one, if an acid be lodged there, or if acid liquors be taken after it, procures ſeveral

ſtools; whereas the common abſorbents, in the ſame circumſtances, inſtead of looſening, bind the belly.

MAGNESIA USTA.
Lond.
Calcined Magneſia.

Take of
White magneſia, four ounces.
Expoſe it to a ſtrong heat for two hours; and, when cold, ſet it by. Keep it in a veſſel cloſely ſtopt.

MAGNESIA USTA.
Edin.
Calcined Magneſia

Let magneſia, put into a crucible, be continued in a red heat for two hours; then put it up in cloſe glaſs veſſels.

The magneſia uſta is uſed for the ſame general purpoſes as the magneſia combined with fixed air. In certain affections of the ſtomach, accompanied with much flatulence, the calcined magneſia is found preferable.

Class VI. *Metals.*

HYDRARGYRUS PURIFICATUS.
Lond.
Purified Quickſilver.

Take of
Quickſilver,
Iron filings, each four pounds.
Rub them together, and diſtil from an iron veſſel.

HYDRARGYRUS ACETATUS.
Lond. Edin.
Acetated Quickſilver.

Take of
Quickſilver;
Dilute nitrous acid, of each half a pound;
Acetated vegetable alkali, three ounces;
Warm water, two pounds and an half.
Digeſt the quickſilver with a gentle heat in the dilute nitrous acid for twenty four hours, or till it be diſſolved. Pour the nitrated quickſilver, thus prepared, into the ſolution of the acetated vegetable alkali in the warm water (at about 90 degrees), ſo that the acetated quickſilver may be formed, which is to be waſhed with cold water, and afterwards diſſolved in a ſufficient quantity of warm water. Filter this ſolution, and ſet it aſide that cryſtals may be formed.

HYDRARGYRUS CALCINATUS.

Lond.

Calcined Quickſilver.

Take of

Purified quickſilver, one pound.

Expoſe the quickſilver, in a flat-bottomed glaſs cucurbit, to an heat of about 600 degrees, in a ſand-bath, till it becomes a red powder.

It may be advantageouſly given in conjunction with opiates: a bolus or pill, containing from half a grain to two grains of this calx, and a quarter, half a grain, or more, of opium, with the addition of ſome warm aromatic ingredient, may be taken every night.

HYDRARGYRUS PRÆCIPITATUS CINEREUS, *vulgo* PULVIS MERCURII CINEREUS.

Edinb.

Aſh-coloured Precipitate of Quickſilver, commonly called *Aſh-coloured Powder of Mercury.*

Take of

Quickſilver,

Dilute nitrous acid, equal weights.

Mix them ſo as to diſſolve the quickſilver: dilute the ſolution with pure water, and add water of ammonia as much as is ſufficient to ſeparate the mercury perfectly from the acid; then waſh the powder with pure water, and dry it.

It may be given in a bolus, in the quantity of from one to ſix or ſeven grains; the doſe being gradually increaſed according to its effects.

HYDRARGYRUS CUM CRETA.

Lond.

Quickſilver and Chalk.

Take of

Purified quickſilver, three ounces;

Powdered chalk, five ounces.

Rub them together until the globules diſappear.

There can be little doubt that the abſorbent earth, by deſtroying acid in the alimentary canal, will diminiſh the activity of the mercury.

HYDRARGYRUS MURIATUS.

Lond.

Muriated Quickfilver.

Take of
Purified quickfilver, two pounds;
Vitriolic acid, thirty ounces;
Dried fea-falt, four pounds.

Mix the quickfilver with the acid, in a glafs veffel, and boil in a fand-heat until the matter be dried. Mix it, when cold, with the fea-falt in a glafs veffel; then fublime in a glafs cucurbit, with a heat gradually raifed. Laftly, let the fublimed matter be feparated from the fcoriæ.

HYDRARGYRUS MURIATUS CORROSIVUS, *vulgo* MERCURIUS SUBLIMATUS CORROSIVUS.

Edin.

Muriated Corrofive Quickfilver, commonly called *Sublimate Corrofive Mercury.*

Take of
Quickfilver,
Dilute nitrous acid, of each four ounces;
Dry fea-falt,
Dried vitriolated iron, of each five ounces;

Diffolve the quickfilver in the nitrous acid, and evaporate the folution to a white and thoroughly dry mafs; then add the fea-falt and vitriolated iron. Having ground and mixed them well together, put the whole into a phial, one half of which they ought to fill; then fublime in fand, firft with a gentle, but afterwards with an increafed heat.

Sublimate, diffolved in vinous fpirit, has been given internally in larger dofes; from a quarter of a grain to half a grain.

CALOMELAS.

Lond.

Calomel.

Take of
Muriated quickfilver, one pound;
Purified quickfilver, nine ounces.

Rub them together till the globules difappear, and then fublime the mafs. In the fame manner repeat the fublimation four times; afterwards rub the matter into a very fine powder, and wafh it by pouring on boiling diftilled water.

HYDRARGYRUS MURIATUS MITIS, *vulgo* CALOMELAS, *sive* MERCURIUS DULCIS.
Edin.

Mild Muriated Quickfilver, commonly called *Colomel*, or *Sweet Mercury*.

Take of

Muriated corrofive quickfilver, reduced to a powder in a glafs mortar, four ounces;

Pure quickfilver, three ounces and a half.

Mix them well together, by long trituration in a glafs or marble mortar, until the quickfilver ceafes to appear. Put the powder into an oblong phial, of fuch a fize that only one-third of it may be filled; and fet the glafs in fand, that the mafs may fublime. After the fublimation break the glafs, and the red powder which is found in its bottom, with the whitifh one that fticks about the neck, being thrown away, let the remaining mafs be fublimed again three or four times, and reduced to a very fine powder.

Calomel, or *mercurius dulcis*, may be confidered as one of the moft ufeful of the mercurial preparations, efpecially in the cafes of children.

HYDRARGYRUS MURIATUS MITIS.
Lond.

Mild Muriated Quickfilver.

Take of

Purified quickfilver,

Dilute nitrous acid, of each half a pound.

Mix in a glafs veffel, and fet it afide until the quickfilver be diffolved. Let them boil, that the falt may be diffolved. Pour out the boiling liquor into a glafs veffel, containing a boiling hot folution of four ounces of fea-falt in eight pints of water.

After a white powder has fubfided to the bottom of the veffel, let the liquor fwimming at the top be poured off, and the remaining powder be wafhed till it becomes infipid, with frequent affufions of hot water: then dried on blotting paper, with a gentle heat.

HYDRARGYRUS MURIATUS PRECIPITATUS.
Edin.

Precipitated Muriated Quickfilver.

Take of

Dilute nitrous acid, eight ounces;

Quickfilver, eight ounces or a little more.

Pour them into a chemical phial, loofely covered, and let them ftand for an hour, avoiding the vapours. Afterwards place the phial in a fand bath for four hours, gradually increafing the heat till the mixture boils for about a quarter of an hour, frequently fhaking the veffel occafionally. If the quickfilver be all diffolved, it will be

neceſſary to add more, that the ſolution may be a perfectly ſaturated one. This ſolution muſt be poured boiling hot into another veſſel, containing a boiling hot ſolution of four ounces and an half of ſea ſalt in eight pounds of water. The mixture muſt be performed quickly, and with a briſk agitation of the veſſel in which it is made. When the precipitate has ſubſided, pour off the liquor, and waſh the precipitate well by frequent additions of boiling water and ſubſequent decantations, until no ſaline taſte is perceptible.

HYDRARGYRUS NITRATUS RUBER.
Lond.
Red Nitrated Quickſilver.

Take of
Purified quickſilver,
Nitrous acid, of each one pound;
Muriatic acid, one drachm
Mix in a glaſs veſſel, and diſſolve the quickſilver in a ſand-bath; then raiſe the fire until the matter be formed into red cryſtals.

HYDRARGYRUS NITRATUS RUBER, *vulgo* MERCURIUS PRÆCIPITATUS RUBER.
Edinb.
Red Nitrated Quickſilver, commonly called *Red Precipitated Mercury.*

Take of
Quickſilver,
Diluted nitrous acid, of each one pound.
Let the quickſilver be diſſolved in the acid, and then let the ſolution be evaporated to a white dry maſs. This being beat into a powder, muſt be put into a glaſs cucurbit, and ſubjected to a fire gradually increaſed, conſtantly ſtirring the maſs with a glaſs rod, that it may be equally heated, till a ſmall quantity of it taken out in a glaſs ſpoon and allowed to cool, aſſumes the form of ſhining red ſquamæ; when the veſſel is to be removed from the fire.

Some have ventured to give this medicine internally, in venereal, ſcrophulous, and other obſtinate chronic diſorders, in doſes of two or three grains, or more.

CALX HYDRARGYRI ALBA.
Lond.
White Calx of Quickſilver.

Take of
Muriated quickſilver,
Sal ammoniac,
Water of kali, each half a pound.

Dissolve first the sal ammoniac, afterwards the muriated quicksilver, in distilled water, and add the water of kali. Wash the precipitated powder until it becomes insipid.

This preparation is used chiefly in ointments.

HYDRARGYRUS CUM SULPHURE.
Lond.
Quicksilver with Sulphur.

Take of
Purified quicksilver,
Flowers of sulphur, each one pound.
Rub them together until the globules disappear.

HYDRARGYRUS SULPHURATUS NIGER, *vulgo* ÆTHIOPS MINERALIS.
Edinb.
Black Sulphurated Quicksilver, commonly called *Ethiop's Mineral.*

Take of
Quicksilver,
Flowers of sulphur, each equal weights.
Grind them together in a glass or stone mortar, with a glass pestle, till the mercurial globules totally disappear.
An Ethiops is made also with a double quantity of mercury.

HYDRARGYRUS SULPHURATUS RUBER.
Lond.
Red Sulphurated Quicksilver.

Take of
Quicksilver purified, forty ounces;
Sulphur, eight ounces.
Mix the quicksilver with the melted sulphur; and if the mixture takes fire, extinguish it by covering the vessel; afterwards reduce the mass to powder, and sublime it.

Cinnabar is sometimes used in fumigations against venereal ulcers in the nose, mouth, and throat. Half a drachm of it burnt, and the fume taken in with the breath, has occasioned a violent salivation.

HYDRARGYRUS VITRIOLATUS.
Lond.
Vitriolated Quicksilver.

Take of
Purified quicksilver, one pound;
Vitriolic acid, fifteen ounces.

Mix in a glass vessel, and heat them by degrees, until they unite into a white mass, which is to be perfectly dried with a strong fire. This matter, on the affusion of a large quantity of hot distilled water, immediately becomes yellow, and falls to powder. Rub the powder carefully with this water in a glass mortar. After the powder has subsided, pour off the water; and adding more distilled water several times, wash the matter till it becomes insipid.

HYDRARGYRUS VITRIOLATUS FLAVUS, *vulgo* TURPETHUM MINERALE.

Edinb.

Yellow Vitriolated Quicksilver, commonly called *Turbith Mineral*.

Take of

Quicksilver, four ounces;
Vitriolic acid, eight ounces.

Cautiously mix them together, and distil in a retort, placed in a sand-furnace, to dryness; the white calx, which is left at the bottom, being ground to powder, must be thrown into warm water. It immediately assumes a yellow colour, but must afterwards be purified by repeated ablutions.

This medicine was lately recommended as the most effectual preservative against the hydrophobia. The washings of turbith mineral are used by some, externally, for the cure of the itch and other cutaneous foulnesses.

SOLUTIO MERCURIALIS SIMPLEX.

Jo. Jac. Plenck.

Simple Mercurial Solution.

Take of

Purest quicksilver, one drachm;
Gum arabic, two drachms.

Rub them in a stone mortar, adding by little and little distilled water of fumitory, till the mercury thoroughly disappear in the mucilage. Having beat and mixed them thoroughly, add by degrees, and at the same time rubbing the whole together,

Syrup of kermes, half an ounce;
Distilled water of fumitory, eight ounces.

GENERAL TABLE OF MERCURY.

Mercury, purified by distillation, is always employed in medicine in a state of oxydation, and this is either effected by

1. Triture, as in the

Pil. Hydrargyri. L. et E.
Hydragyrus cum creta. L.

Emplaſt. hydrargyr. ſive cærul. E.
——— Lithargyr. cum hydrargyr. L.
——— Ammoniaci cum hydrargyr. L.
Ungt. hydrargyr. ſive cærul. E.
——— fort. et mitius. L.

2. Calcination, (the action of heat and air,) as in the
Hydrargyrus calcinatus. L.

3. Acids, as by the

1. SULPHURIC ACID, in the
Hydrargyr. vitriolat. flavus, or turpeth mineral. E.
——— vitriolatus. L.

2. NITRIC ACID, in the
Ungt. hydrargyr. nitrat. L. et E.
——— nitrat. ruber. L. et E.

3. MURIATIC ACID, in the
Hydrargyrus muriatus corroſivus. E.
Hydrargyrus muriatus. L.
Hydrargyrus muriatus mitis. E.
Calomelas. L.
Hydrargyrus muriatus precipitat. E.
Hydrargyrus muriatus mitis. L.

4. ACETOUS ACID, in the
Hydrargyrus acetatus. L. et E.
Pilulæ Keyſeri.

5. PHOSPHORIC ACID, in the
Hydrargyrus phoſphoratus.

3. Mercury is deoxydated in part,

1. In the Calcined State by its Union with SULPHUR, as in the

Hydrargyrus ſulphuratus niger. E.
——— cum ſulphure. L.
Hydrargyrus ſulphuratus ruber. L.
Pilulæ hydrargyri muriat mitis, ſive calomelanos compoſitæ. E.

2. In the Saline State, by its Precipitation by ALKALIES, as in the

Hydrargyr. precipit. cinereus. E.
Calx hydrargyr. alba. L.
Ungt. calcis hydrargyr. albæ. L.

Preparations of Antimony.

ANTIMONIUM CALCINATUM.

Lond.

Calcined Antimony.

Take of
Antimony, powdered, eight ounces;
Nitre, powdered, two pounds.
Mix them, and cast the mixture by degrees into a red hot crucible. Burn the white matter about half an hour; and, when cold, powder it; after which wash it with distilled water.

ANTIMONIUM USTUM CUM NITRO, *vulgo* CALX ANTIMONII NITRATA.

Edinb.

Nitrated Calx of Antimony.

Take of
Antimony, calcined for making the glass of antimony,
Nitre, equal weights.
Having mixed, and put them into a crucible, let them be heated, so that the matter shall be of a red colour for an hour; then let it be taken out of the crucible, and, after powdering it, let it be repeatedly washed with warm water till it becomes insipid.

It is in all cases uncertain in operation: sometimes proving perfectly inert, and at other times very violent in its effects.

CROCUS ANTIMONII.

Lond.

Crocus of Antimony.

Take of
Antimony, powdered;
Nitre, powdered, of each one pound;
Sea-salt, one ounce.
Mix, and put them by degrees into a red hot crucible, and melt them with an augmented heat. Pour out the melted matter; and, when cold, separate it from the scoriæ.

CROCUS ANTIMONII, *vulgo* CROCUS METALLORUM.

Edinb.

Crocus of Antimony, commonly called *Crocus of Metals.*

Take of
Antimony,
Nitre, equal weights.

After they are ſeparately powdered and well mixed, let them be injected by degrees into a red-hot crucible; when the detonation is over, ſeparate the reddiſh metallic matter from the whitiſh cruſt; powder it and edulcorate it by repeated waſhings with hot water, till the water come off inſipid.

Their principal uſe is in maniacal caſes, or as the baſis of ſome other preparations.

ANTIMONIUM MURIATUM.

Lond.

Muriated Antimony.

ANTIMONIUM MURIATUM, *vulgo* BUTYRUM ANTIMONII.

Edinb.

Muriated Antimony, commonly called *Butter of Antimony.*

Take of
  Crocus of antimony, powdered,
  Vitriolic acid, each one pound;
  Dry ſea-ſalt, two pounds.

Pour the vitriolic acid into a retort, adding by degrees the ſea-ſalt and crocus of antimony, previouſly mixed; then diſtil in a ſand-bath. Let the diſtilled matter be expoſed to the air ſeveral days, and then let the fluid part be poured off from the dregs.

It is ſufficiently ſtrong for the purpoſes of conſuming fungous fleſh and the callous lips of ulcers.

PULVIS ANTIMONIALIS.

Lond.

Antimonial Powder.

Take of
  Antimony, coarſely powdered,
  Hartſhorn ſhavings, each two pounds.

ANTIMONIUM CALCAREO PHOSPHORATUM, *ſive* PULVIS ANTIMONIALIS.

Edinb.

Calcareo-Phoſphorated Antimony, or *Antimonial Powder.*

Take of
  Antimony, in coarſe powder, two pounds;
  Saw-duſt of bones, ivory, or hartſhorn, two pounds.

Mix, and put them into a wide red-hot iron pot, ſtirring conſtantly till the maſs acquires a grey colour. Powder the matter when cold,

and put it into a coated crucible. Lute to it another crucible inverted, which has a small hole in its bottom; augment the fire by degrees to a red heat, and keep it so for two hours. Lastly, reduce the matter, when cold, to a very fine powder.

This powder is given as an alterative and sudorific in doses of about five, six, or seven grains; in which quantity it frequently produces nausea, and sometimes vomiting and purging. Its principal use is in removing obstructions or suppressions of the insensible perspiration which so often produce fevers.

SULPHUR ANTIMONII PRÆCIPITATUM.
Lond.

Precipitated Sulphur of Antimony.

Take of
- Antimony, powdered, two pounds;
- Water of pure kali, four pints;
- Distilled water, three pints.

Mix, and boil them with a slow fire for three hours, constantly stirring, and adding distilled water as it shall be wanted; strain the hot ley through a double linen cloth, and into the liquor, while yet hot, drop by degrees as much diluted vitriolic acid as is sufficient to precipitate the sulphur. Wash off the vitriolated kali with warm water.

SULPHUR ANTIMONII PRÆCIPITATUM, *vulgo* SULPHUR AURATUM ANTIMONII.
Edinb.

Precipitated Sulphur of Antimony, commonly called *Golden Sulphur of Antimony.*

Take of
- Caustic ley, four pounds;
- Water, three pounds;
- Antimony powdered two pounds.

Boil them in a covered iron pot for three hours, adding more water if necessary, frequently stirring the mixture with an iron spatula; strain the liquor while warm through a double cloth, and add as much diluted vitriolic acid as is necessary to precipitate the sulphur, which must be well washed with plenty of water.

They prove emetic when taken on an empty stomach, in a dose of four, five, or six grains; but at present they are scarcely prescribed with this intention; being chiefly used as alterative deobstruents, particularly in cutaneous disorders.

ANTIMONIUM TARTARISATUM.
Lond.
Tartarised Antimony.

Take of
Crocus of antimony, powdered, one pound and an half;
Cryſtals of tartar, two pounds;
Diſtilled water, two gallons.
Boil in a glaſs veſſel about a quarter of an hour; filter through paper, and let aſide the ſtrained liquor to cryſtallize.

ANTIMONIUM TARTARISATUM, *vulgo* TARTARUS EMETICUS.
Edinb.
Tartariſed Antimony, commonly called *Emetic Tartar.*

Take of
Muriated antimony what quantity you pleaſe; pour it into warm water, in which a proper quantity of purified lixive has been previouſly diſſolved, that the antimonial powder may be precipitated, which after being well waſhed is to be dried.
Then to five pounds of water add of this powder nine drachms, and of cryſtals of tartar, in very fine powder, two ounces and a half; boil for a little till the powders be diſſolved.
Let the ſtrained ſolution be ſlowly evaporated in a glaſs veſſel to a pellicle, ſo that cryſtals may be formed.

The doſe of emetic tartar, when deſigned to produce the full effect of an emetic, is from two to four grains. It may likewiſe be advantageouſly given in much ſmaller doſes, as a nauſeating and ſudorific medicine.

ANTIMONIUM VITRIFICATUM.
Lond.
Vitrified Antimony.

Take of
Powdered antimony, four ounces
Calcine in a broad earthen veſſel with a fire gradually raiſed, ſtirring it with an iron rod until it no longer emits ſmoke. Put this powder into a crucible, ſo as to fill two thirds of it. A cover being fitted on, make a fire under it, at firſt moderate, afterwards ſtronger, until the matter be melted. Pour out the melted glaſs.

VITRUM ANTIMONII.
Edinb.
Glaſs of Antimony.

Strew antimony, beat into a coarſe powder like ſand, upon a ſhallow unglazed earthen veſſel, and apply a gentle heat underneath, that

the antimony may be heated ſlowly; keeping it at the ſame time conſtantly ſtirring to prevent it from running into lumps. White vapours of a ſulphureous ſmell will ariſe from it. If they ceaſe to exhale with the degree of heat firſt applied, increaſe the fire a little, ſo that vapours may again ariſe: go on in this manner, till the powder, when brought to a red heat, exhales no more vapours. Melt this powder in a crucible with an intenſe heat, till it aſſumes the appearance of melted glaſs; then pour it out on a heated braſs plate or diſh.

It is frequently employed in the formation of emetic tartar.

VITRUM ANTIMONII CERATUM.

Edinb.

Cerated Glaſs of Antimony.

Take of
Yellow wax, a drachm;
Glaſs of antimony, reduced into powder, an ounce.
Melt the wax in an iron veſſel, and throw into it the powdered glaſs; keep the mixture over a gentle fire for half an hour, continually ſtirring it; then pour it out on paper, and when cold, grind it into powder.

The doſe of this medicine is from ten grains to twenty or thirty: it is ſaid to operate mildly both upwards and downwards, and ſometimes to prove ſudorific.

CERUSSA ANTIMONII.

Brun.

Ceruſſe of Antimony.

Take of
Regulus of antimony, one part;
Nitre, three parts
Deflagrate them together in the manner directed for the antimonium calcinatum.

KERMES MINERALE.

Suec.

Kermes Mineral.

Take of
Crude antimony, powdered, half a pound;
Fixed vegetable alkali, two pounds;
Boiling water, eight pounds
Boil them together in an iron pot for a quarter of an hour, continually ſtirring the mixture with an iron ſpatula, and filter as ſpeedily as

poſſible while it is hot. The filtered liquor, ſet in a cool place, will ſoon depoſit a powder, which muſt be repeatedly waſhed, firſt with cold, and afterwards with warm, water until it be perfectly inſipid.

This medicine has been long greatly eſteemed, eſpecially in France.

PANACEA ANTIMONII.

Panacea of Antimony.

Take of
 Antimony, ſix ounces;
 Nitre, two ounces;
 Common ſalt, an ounce and a half;
 Charcoal, an ounce.

Reduce them into a fine powder, and put the mixture into a red hot crucible, by half a ſpoonful at a time, continuing the fire a quarter of an hour after the laſt injection; then either pour the matter into a cone, or let it cool in the crucible; which when cold muſt be broken to get it out. In the bottom will be found a quantity of regulus; above this a compact liver-coloured ſubſtance; and on the the top a more ſpongy maſs; this laſt is to be reduced into powder, edulcorated with water, and dried, when it appears of a fine golden colour.

Ten grains of the powder, mixed with an ounce of white ſugar candy, and made into a maſs with mucilage of gum tragacanth, may be divided into an hundred ſmall pills; of which one, two, or three, taken at a time, are ſaid to work gently by ſtool and vomit.

TABLE OF ANTIMONY.

Antimony is chiefly employed in medicine in the ſtate of oxydation, and this oxyd is procured either from its ſulphuret or its pure ſtate.

I. Antimony in the form of the triturated ſulphuret.

Antimonium preparatum (L. et E.) is oxydated by

1. Calcination, (or the action of heat and air,) as in the
 Flores antimonii ſine addito.
 Vitrum antimonii. E.
 Antimonium vitrificatum. L.
 Vitrum antimonii ceratum. E.

2. Acids, as in the
 Antimonium vitriolatum. Klapnig.
 Antimonium catharticum. Wilſon.

Antimonium muriatum, vulgo Butyr. Antim. E.
Antimonium muriatum. L.
Pulvis algarothi, vulgo mercurius vitae.
Bezoardicum minerale.
Antim. tartarifat. vulgo tartar emetic. E.
Antim. tartarifat. E. et L.
Vinum antim tartarifat. E. et L.
Vinum antimonii. L.

3. Nitre.
Crocus antimonii mitiffimus,
Vulgo regulus antimonii medicinalis.
Crocus antimonii. E. et L.
Antimonii emeticum mitius. Boerh.
Antimonium uftum cum nitro, vulgo calx antimonii nitrata. E.
Antimonium calcinatum, vulgo diaphoret. L.
Antimonium calcareo-phofphoratum, five pulvis antimonialis. E.
Pulvis antimonialis. L.

4. Alkalies.
Hepar antimonii mitiffimus
Regulus antimonii medicinalis.
Hepar ad Kermes minerale. Geoffroi.
Hepar ad tincturam antimonii.
Kermes mineralis.
Sulphur antimonii praecipitatum. E. et L.

II. Antimony, in its pure ftate, under the forms of
Regulus antimonii fimplex,
Regulus antimonii martialis,
Regulus Jovialis, are oxydated by

1. Calcination, (or the action of heat and air,) as in the
Flores argentii, vulgo nix antimonii.

2. Nitre, as in the
Ceruffa antimonii.
Stomaichcum poterii.
Antihecticum poterii.
Cardiacum poterii.

Preparations of Silver.

ARGENTUM NITRATUM.
Lond.
Nitrated Silver.

Take of
Silver, one ounce;
Dilute nitrous acid, four ounces.

Dissolve the silver in the nitrous acid, in a glass vessel with a sand-heat; then evaporate with an heat gently raised; afterwards melt the residuum in a crucible, carefully avoiding too a great a heat, and pour it into proper moulds.

ARGENTUM NITRATUM, *vulgo* CAUSTICUM LUNARE. *Edinb.*

Nitrated Silver, commonly called *Lunar Caustic.*

Take of
- Purest silver, beat thin and cut in pieces, four ounces;
- Dilute nitrous acid, eight ounces;
- Distilled water, four ounces.

Dissolve the silver in a phial with a gentle heat, and evaporate the solution to dryness; then put the mass into a large crucible, and apply the heat, at first gently, but augment it by degrees till the mass flows like oil; then pour it into iron moulds, previously heated, and greased with tallow. The lunar caustic must be kept in well stopt phials.

This preparation is a strong caustic; and is frequently employed as such, for consuming warts and other fleshy excrescences, keeping down fungous flesh in wounds or ulcers, and other similar uses.

PILULÆ LUNARES.

The Lunar Pills.

Dissolve pure silver in aqua fortis, as in the foregoing process; and after due evaporation, set the liquor to crystallize Let the crystals be again dissolved in common water, and mixed with a solution of equal their weight of nitre. Evaporate this mixture to dryness, and continue the exsiccation with a gentle heat, keeping the matter constantly stirring till no more fumes arise.

Boerhaave, Boyle, and others, commend it highly in hydropic cases. It is used also in nervous affections.

Preparations of Iron.

FERRI LIMATURA PURIFICATA. *Edinb.*

Purified Iron Filings.

Cover the filings with a piece of gauze, or with the bottom of a fine sieve, and through this draw the iron filings with a magnet.

FERRI SQUAMÆ PURIFICATÆ.
Edinb.
Purified Iron Scales.

Let iron ſcales (collected at the foot of a blackſmith's anvil) be purified by means of a magnet. The magnet will attract only the ſmaller and more pure ſcales, leaving the larger and more impure behind.

FERRUM AMMONIACALE.
Lond.
Ammoniacal Iron.

Take of
Iron filings, one pound;
Sal ammoniac, two pounds.

Mix, and ſublime. What remains at the bottom of the veſſel mix by rubbing together with the ſublimed matter, and again ſublime.

FERRUM AMMONIACUM, *vulgo* FLORES MARTIALES.
Edinb.
Ammoniated Iron, commonly called *Martial Flowers.*

Take of
Burnt vitriolated iron, waſhed and well dried,
Sal ammoniac, equal weights.

Having mixed them well, ſublime.

It has been found of ſervice in hyſterical and hypochondriacal caſes, and in diſtempers proceeding from a laxity and weakneſs of the ſolids, as the rickets.

FERRI RUBIGO.
Lond.
Ruſt of Iron.

Take of
Iron filings, one pound.

Expoſe them to the air, often moiſtening them with water, until they be corroded into ruſt; then powder them in an iron mortar, and waſh off with diſtilled water the very fine powder.

But the remainder, which cannot by moderate rubbing be reduced into a powder, capable of being eaſily waſhed off, muſt be moiſtened, expoſed to the air for a longer time, and again powdered and waſhed as before. Let the waſhed powder be dried.

FERRI RUBIGO, *vulgo* FERRI LIMATURA PREPARATA.
Edinb.
Ruſt of Iron, commonly called *Prepared Iron Filings.*

Set purified iron filings in a moiſt place, that they may turn to ruſt, which is to be ground into an impalpable powder.

The ruſt of iron is preferable, as a medicine, to the calces, or croci, made by a ſtrong fire. The doſe is from four or five grains to twenty or thirty.

FERRUM TARTARISATUM.
Lond.
Tartariſed Iron.

Take of
Iron filings one pound;
Powdered cryſtals of tartar, two pounds.
Mix them with diſtilled water into a thick paſte. Expoſe it to the air in an open earthen veſſel for eight days; then dry the matter in a ſand-bath, and reduce it to a very fine powder.

It may be given in a liquid form, or in a bolus, in doſes of from five grains to a ſcruple, twice or thrice a day.

FERRUM VITRIOLATUM.
Lond.
Vitriolated Iron.

Take of
Iron filings,
Vitriolic acid, each eight ounces;
Diſtilled water, three pints.
Mix them in a glaſs veſſel; and, when the efferveſcence has ceaſed, place the mixture for ſome upon hot ſand; then pour off the liquor, ſtraining it through paper; and, after due exhalation, ſet it aſide to cryſtallize.

FERRUM VITRIOLATUM, *vulgo* SAL CHALYBIS.
Edinb.
Vitriolated Iron, commonly called *Salt of Steel.*

Take of
Purified iron filings, ſix ounces;
Vitriolic acid, eight ounces;
Water, two pounds and a half.
Mix them, and when the efferveſcence ceaſes, let the mixture ſtand for ſome time upon warm ſand; then ſtrain the liquor through paper, and after due evaporation ſet it aſide to cryſtallize.

The vitriolated iron is one of the moſt efficacious preparations of this metal; and frequently uſed in cachectic and chlorotic caſes, for exciting the uterine purgations, ſtrengthening the tone of the viſcera, and deſtroying worms. Four or five grains, and in many caſes half a

grain, are ſufficient for the intention in which chalybeate medicines are given.

FERRUM VITRIOLATUM EXSICCATUM, *vulgo* VITRIOLATUM CALCINATUM.

Edinb.

Dried Vitriolated Iron, commonly called *Calcined Vitriol.*

Take of

Vitriolated iron, as much as you pleaſe.

Let it be calcined in an unglazed earthen veſſel, with a moderate heat, till it becomes white and perfectly dry.

FERRUM VITRIOLATUM USTUM, *vulgo* COLCOTHAR VITRIOLI.

Edinb.

Burnt Vitriolated Iron, commonly called *Colcothar of Vitriol.*

Let dried vitriolated iron be urged with a violent fire till it becomes of a very red colour.

The colcothar is very rarely employed.

ÆTHIOPS MARTIALIS.

Gen.

Martial Ethiops.

Take of

Ruſt of iron, as much as you pleaſe;

Olive oil, a ſufficient quantity to make it into a paſte.

Let this be diſtilled in a retort by a ſtrong fire to dryneſs. Keep the reſiduum reduced to a fine powder in a cloſe veſſel.

It is not in general ſuppoſed to have any advantage over the other more common chalybeates.

Preparations of Lead.

MINIUM.

Red Lead.

Let any quantity of lead be melted in an unglaſed earthern veſſel, and kept ſtirring with an iron ſpatula till it falls into a powder, at firſt blackiſh, afterwards yellow, and at length of a deep red colour, in which laſt ſtate it is called *minium*; taking care not to raiſe the fire ſo high as to run the calx into a vitreous maſs.

Theſe calces are employed in external applications for abating inflammations, cleanſing and healing ulcers, and the like.

CERUSSA.

Ceruſſe, or White Lead.

Put ſome vinegar into the bottom of an earthen veſſel, and ſuſpend over the vinegar very thin plates of lead, in ſuch a manner that the vapour which ariſes from the acid may circulate about the plates. Set the containing veſſel in the heat of horſe dung for three weeks; if at the end of this time the plates be not properly calcined, ſcrape off the white powder, and expoſe them again to the ſteam of vinegar, till all the lead be thus corroded into powder.

It proves externally, when ſprinkled on running ſores, or ulcers, moderately cooling, drying, and aſtringent.

CERUSSA ACETATA.

Lond.

Acetated Ceruſſe.

Take of
 Ceruſſe, one pound;
 Diſtilled vinegar, one gallon.

Boil the ceruſſe with the vinegar until the vinegar is ſaturated; then filter through paper; and, after proper evaporation, ſet it aſide to cryſtallize.

CERUSSA ACETATA, *vulgo* SACCHARUM SATURNI.

Edinb.

Acetated Ceruſſe, commonly called *Sugar of Lead.*

Put any quantity of ceruſſe into a cucurbit, and pour upon it ten times its quantity of diſtilled vinegar. Let the mixture ſtand upon warm ſand till the vinegar becomes ſweet; when it is to be poured off, and freſh vinegar added as often as it comes off ſweet. Then let all the vinegar be evaporated in a glaſs veſſel to the conſiſtence of pretty thin honey, and ſet it aſide in a cold place, that cryſtals may be formed, which are to be afterwards dried in the ſhade The remaining liquor is again to be evaporated that new cryſtals may be formed; the evaporation of the reſiduous liquor is to be repeated till no more cryſtals concrete.

The ſugar of lead is much more efficacious than the foregoing preparations, in anſwering the ſeveral intentions to which they are applied. Some have ventured upon it internally, in doſes of a few grains, as a ſtyptic, in hæmorrhages, profuſe colliquative ſweats, ſeminal fluxes, the fluor albus, &c. nor has it failed their expectations. It very powerfully reſtrains the diſcharge; but almoſt as certainly as it does this, it occaſions ſymptoms of another

kind, often more dangerous than thofe removed by it, and fometimes fatal.

AQUA LITHARGYRI ACETATI.

Lond.

Water of Acetated Litharge.

Take of

Litharge, two pounds and four ounces;

Diftilled vinegar, one gallon.

Mix, and boil to fix pints, conftantly ftirring; then fet it afide. After the fæces have fubfided, ftrain.

This preparation may be confidered as nearly the fame with the extract and vegeto-mineral water of Mr. Goulard.

Preparations of Tin.

PULVIS STANNI.

Lond.

Tin Powder.

Take of

Tin, four ounces.

Melt it, and take off the film formed on its furface; then pour it into a clear iron veffel, and either by agitation or rubbing reduce it to a powdery ftate; pafs the finer parts through a hair fieve.

It is often employed as a remedy againft worms, particularly the flat kinds, which too often elude the force of other medicines. The general dofe is from a fcruple to a drachm.

STANNI AMALGAMA.

Dan.

Amalgama of Tin.

Take of

Shavings of pure tin, two ounces;

Pure quickfilver, three drachms.

Let them be rubbed to a powder in a ftone mortar.

Some have imagined that tin thus acted on by mercury, is in a more active condition than when exhibited in the ftate of powder, and accordingly it has been given in worm cafes.

Preparations of Zinc.

ZINCUM CALCINATUM.

Lond.

Calcined Zinc.

Take of

Zinc, broken into ſmall pieces, eight ounces.

Caſt the pieces of zinc, at ſeveral times, into an ignited large and deep crucible, placed leaning, or half-upright, putting on it another crucible in ſuch a manner that the air may have free acceſs to the burning zinc.

Take out the calx as ſoon as it appears, and ſeparate its white and lighter part by a fine ſieve.

ZINCUM USTUM, *vulgo* FLORES ZINCI.

Edinb.

Burnt Zinc, commonly called *Flowers of Zinc.*

Let a large crucible be placed in a furnace, in an inclined ſituation, only half upright; when the bottom of the veſſel is moderately red, put a ſmall piece of zinc, about the weight of a drachm, into it: the zinc ſoon flames, and is at the ſame time converted into a ſpongy calx, which is to be raked from the ſurface of the metal with an iron ſpatula, that the combuſtion may proceed the more ſpeedily: when the zinc ceaſes to flame, take the calx out of the crucible Having put in another piece of zinc, the operation may be repeated as often as you pleaſe. Laſtly, the calx is to be prepared like antimony.

The flowers of zinc have been much celebrated of late years in the cure of epilepſy, and ſeveral ſpaſmodic affections. They ought to be given at firſt in very ſmall doſes, as a grain or two twice a day: and the doſe gradually increaſed to ſeven or eight grains.

ZINCUM VITRIOLATUM, *vulgo* VITRIOLUM ALBUM.

Edinb.

Vitriolated Zinc, commonly called *White Vitriol.*

Take of

Zinc, cut into ſmall pieces, three ounces;

Vitriolic acid, five ounces;

Water, twenty ounces.

Having mixed the acid and water, add the zinc, and when the ebullition is finiſhed ſtrain the liquor; then after proper evaporation ſet it apart in a cold place, that it may ſhoot into cryſtals.

This ſalt is an elegant white vitriol.

ZINCUM VITRIOLATUM.
Lond.
Vitriolated Zinc.

Take of
White vitriol, one pound;
Vitriolic acid, one drachm;
Boiling diſtilled water, three pints.
Mix, and filter through paper. After a proper evaporation, ſet it aſide in a cold place to cryſtallize.

Preparations of Copper.

CUPRUM AMMONIACUM.
Edinb.
Ammoniacal Copper.

Take of
Vitriolated copper, two parts;
Prepared ammonia, three parts.
Rub them together in a glaſs mortar, until they unite, after the effervescence ceaſes, into a uniform violet-coloured maſs, which muſt be firſt dried on blotting paper, and afterwards by a gentle heat. The product muſt be kept in a glaſs phial well cloſed with a glaſs ſtopper.

This preparation has been thought ſerviceable in epilepſies. It is employed by beginning with doſes of half a grain, twice a day; and increaſing them gradually to as much as the ſtomach will bear.

AQUA ÆRUGINIS AMMONIATÆ, *vulgo* AQUA SAPPHARINA.
Edinb.
Water of Ammoniated Verdigris, commonly called *Sapphire Water.*

Take of
Lime water, freſh made, eight ounces;
Sal ammoniac, two ſcruples;
Verdigris powdered, four grains.
Mix them, and after twenty-four hours filter the liquor.

This water is uſed externally for cleaning foul ulcers, and diſpoſing them to heal.

AQUA CUPRI VITRIOLATA COMPOSITA, *vulgo* AQUA STYPTICA.
Edinb.
Compound Water of Vitriolated Copper, commonly called *Styptic Water.*

Take of
Vitriolated copper,

Alum, of each three ounces;
Water, two pounds;
Vitriolic acid, one ounce and an half.

Boil the salts in the water that they may be dissolved, and to the filtred liquor add the vitriolic acid.

This styptic water is somewhat similar to the old *aqua aluminosa Bateana* of the former pharmacopœias.

Decoctions and Infusions.

After the several classes of medical substances described, we come next to vegetables, the forms of which, or at least the forms in which the vegetable substance predominates, are more varied than what we have hitherto considered.

Most vegetable substances impart their virtues to water, and this they do more readily in a dried than in a fresh state, which is assisted sometimes by the application of heat; too much heat, however, is improper in the more aromatic vegetables, as their volatile parts are dissipated by it, but it may be applied to those of a more fixed nature, and is sometimes necessary to extract all the virtues of particular substances; yet this circumstance is by no means so general, and cold infusions are found for the most part more fully impregnated with the medicinal qualities than the hot ones.

DECOCTUM ALTHÆÆ.
Edinb.
Decoction of Marshmallows.

Take of
Dried marshmallow roots, four ounces;
Raisins of the sun, stoned, two ounces;
Water, seven pounds.

Boil to five pounds; place apart the strained liquor till the feces have subsided, then pour out the clear liquor.

This forms a useful demulcent in nephritic cases, and wherever acrimony takes place in the discharge by the kidneys.

DECOCTUM CORNU CERVI.
Lond.
Decoction of Hartshorn.

Take of
Burnt and prepared hartshorn, two ounces;

Gum arabic, six drams;
Distilled water, three pints.
oil, constantly stirring, to two pints, and strain.

This forms the drink in acute diseases attended with iarrhœa, and where much acrimony prevails in the primæ iæ.

POTIO CRETACEA.

Lond.

Chalk Julep.

'ake of
Prepared chalk, one ounce;
Purest refined sugar, half an ounce;
Mucilage of gum arabic, two ounces;
Rub them together; and add by degrees;
Water, two pounds and a half;
Spirituous cinnamon water, two ounces.
Mix them.

This is the best form of exhibiting chalk; it is useful wherever an acrimony prevails in the primæ viæ, connected with an acid cause.

DECOCTUM CORTICIS PERUVIANI.

Lond.

Decoction of Peruvian Bark.

Take of
Peruvian bark, powdered, one ounce;
Distilled water, one pint and three ounces.
Boil, for ten minutes, in a covered vessel, and strain the liquor whilst hot.

In this form all the strengthening virtues of the bark are contained, and it may be given in doses of two or three ounces.

DECOCTUM PRO ENEMATE.

Lond.

Decoction for a Clyster.

Take of
The dried leaves of mallow, one ounce;
Dried chamomile-flowers, half an ounce;
Water, one pint.
Boil, and strain.

The virtues of this form chiefly depend on the quantity of the fluid introduced more than any thing in the composition.

DECOCTUM PRO FOMENTO.

Lond.

Decoction for Fomentation.

Take of

The dried leaves of fouthern-wood,
The dried tops of fea-wormwood,
Dried chamomile-flowers, each one ounce:
Dried bay-leaves, half an ounce;
Diftilled water, fix pints.

Boil them a little, and ftrain.

This form depends much for its virtues on the warm fluid

DECOCTUM COMMUNE.

Edinb.

Common Decoction.

Take of

Camomile-flowers, one ounce;
Carvy-feeds, half an ounce;
Water, five pounds.

Boil a quarter of an hour, and ftrain.

DECOCTUM HELEBORI.

Lond.

Decoction of Hellebore.

Take of

The root of white hellebore, powdered, one ounce;
Diftilled water, two pints;
Rectified fpirit of wine, two ounces.

Boil the water with the root to one pint; and, the liquor being cold and ftrained, add to it the fpirit.

This is fometimes ufed in cutaneous difeafes, particularly the tinea.

DECOCTUM HORDEI.

Lond.

Decoction of Barley.

Take of

Pearl-barley, two ounces;
Diftilled water, four pints.

The barley being firft wafhed with cold water from the adhering impurities, pour upon it about half a pint of water, and boil the barley a little time. This water being thrown away, add the diftilled water, boiling, to the barley; boil it to two pints, and ftrain.

This is a ufeful form for the purpofes of dilution in acute difeafes.

DECOCTUM HORDEI COMPOSITUM.
Lond.
Compound Decoction of Barley.

Take of
The decoction of barley, two pints;
Raifins, ftoned,
Figs, fliced, each two ounces;
Liquorice-root, fliced and bruifed, half an ounce;
Diftilled water, one pint.
Boil to two pints, and ftrain.

DECOCTUM HORDEI.
Edinb.
Barley Water.

Take of
Pearl-barley, two ounces;
Water, five pints.
Firft wafh the barley from the mealy matter that adheres to it with fome cold water; then boil it a little with about half a pint of frefh water, which will acquire a confiderable tinge from it. Throw away this tinged water; put the barley into the water prefcribed, made firft to boil; and continue the boiling till half the water be wafted.

DECOCTUM LIGNORUM.
Edinb.
Decoction of the Woods.

Take of
Guaiacum faw-duft, three ounces;
Raifins of the fun, ftoned, two ounces;
Saffafras wood, fhaved,
Liquorice, fliced, each one ounce,
Water, ten pounds.
Boil the guaiacum and raifins with the water, over a gentle fire, to the confumption of one half; adding, towards the end, the faffafras and liquorice. Strain out the liquor; and having fuffered it to reft for fome time, pour off the clear from the feces without expreffion.

This has been long celebrated in cutaneous difeafes, when taken daily in the quantity of a pint joined with a mercurial or antimonial alterative.

DECOCTUM SARSAPARILLÆ.
Lond.
Decoction of Sarfaparilla.

Take of
The root of farfaparilla, fliced, fix ounces;
Diftilled water, eight pints.
Macerate for two hours, with an heat of about 195°; then take out the root, and brufe it; return the bruifed root to the liquor, and again

macerate it for two hours. Then, the liquor being boiled to the meaſure of four pints, preſs it out, and ſtrain.

This is a mild alterative, poſſeſſing the qualities of a mild mucilaginous ſubſtance with much dilution: a pint or more ſhould be uſed daily.

DECOCTUM SARSAPARILLÆ COMPOSITUM.

Lond.

Compound Decoction of Sarſaparilla.

Take of
 The root of ſarſaparilla, ſliced and bruiſed, ſix ounces;
 Bark of the root of ſaſſafras,
 Shavings of guaiacum-wood,
 Liquorice-root, bruiſed, of each one ounce;
 Bark of the root of mezereon, three drams;
 Diſtilled water, ten pints.

Macerate, with a gentle heat, for ſix hours; then boil it down to five pints, adding towards the end of the boiling the bark of the root of mezereon, and ſtrain the liquor.

This is more active as an alterative than the former, and has been much celebrated as the Liſbon drink.

DECOCTUM SENEKÆ.

Edinb.

Decoction of Seneka.

Take of
 Seneka, or rattleſnake-root, one ounce;
 Water, two pounds.

Boil to ſixteen ounces, and ſtrain.

This decoction has been much uſed in chronic rheumatiſm, in gout, and dropſy, without obſtruction, in the quantity of two ounces four times a day.

DECOCTUM ULMI.

Lond.

Decoction of Elm.

Take of
 The freſh inner-bark of elm, bruiſed, four ounces;
 Diſtilled water, four pints.

Boil to two pints, and ſtrain.

The beech decoction has been much celebrated in cutaneous diſeaſes, but it is uſed with doubtful ſucceſs.

MUCILAGO AMYLI.

Lond.

Mucilage of Starch.

Take of
 Starch, three drams;

Diſtilled water, one pint.
Rub the ſtarch, by degrees adding the diſtilled water; then boil it a little time.

MUCILAGO ARABICI GUMMI.
Lond.
Mucilage of Gum Arabic.

Take of
Gum arabic, powdered, four ounces;
Boiling diſtilled water, eight ounces.
Rub the gum with the water until it be diſſolved.

MUCILAGO GUMMI ARABICI.
Edinb.
Mucilage of Gum Arabic.

Take of
Gum arabic, beat into powder, and warm water, each equal weights.
Digeſt, and frequently ſtir them till the gum be diſſolved, then preſs the ſolution through linen.

MUCILAGO GUMMI TRAGACANTHÆ.
Edinb.
Mucilage of Gum Tragacanth.

Take of
Gum tragacanth, powdered, one ounce;
Hot water, eight ounces.
Macerate twenty-four hours; then mix them, by rubbing briſkly, that the gum may be diſſolved; and preſs the mucilage through linen cloth.

MUCILAGO SEMINIS CYDONII MALI.
Lond.
Mucilage of Quince Seed.

Take of
Seeds of the quince, one dram;
Diſtilled water, eight ounces, by meaſure.
Boil with a ſlow fire until the water thickens; then paſs it through linen.

The various mucilages differ little from each other but in the degrees of their tenacity; the ſtarch is uſed more for clyſters, the reſt in the preparation of other medicines.

INFUSUM GENTIANÆ COMPOSITUM.
Lond.
Compound Infuſion of Gentian.

Take of
The root of gentian, one dram;
Freſh outer-rind of lemons, half an ounce;

Dried outer-rind of Seville oranges, one dram and an half;
Boiling water, twelve ounces, by meafure.

Macerate for an hour, and ftrain.

This is employed in alvine fluxes of a paffive nature. The dofe is a fpoonful every hour.

INFUSUM AMARUM.

Edinb.

Bitter Infufion.

Take of
Gentian root, half an ounce;
Dried peel of Seville oranges, one dram;
Coriander feeds, half a dram;
Proof-fpirit, four ounces;
Water, one pound.

First pour on the fpirit, and three hours thereafter add the water; then macerate without heat for a night, and ftrain.

This is a good ftomachic, and much improved by the addition of the fpirit.

INFUSUM SENNÆ SIMPLEX.

Lond.

Simple Infufion of Senna.

Take of
Senna, an ounce and a half;
Ginger, powdered, one dram;
Boiling diftilled water, one pint.

Macerate them for one hour, in a covered veffel; and, the liquor, being cold, ftrain it.

This aromatic infufion is ufed in an ounce or two for a dofe.

INFUSUM SENNÆ TARTARISATUM.

Lond.

Tartarifed Infufion of Senna.

Take of
Senna, one ounce and a half;
Coriander-feeds, bruifed, half an ounce;
Cryftals of tartar, two drams;
Diftilled water, one pint.

Diffolve the cryftals of tartar by boiling in the water; then pour the water, as yet boiling, on the fenna and feeds. Macerate for an hour in a covered veffel, and ftrain when cold.

This is confidered as an improvement on the former. The addition of the tartar preventing its griping tendency.

INFUSUM TAMARINDORUM CUM SENNA.

Edin.

Infusion of Tamarinds with Senna.

Take of

Tamarinds, six drams;
Crystals of tartar,
Senna, each one dram;
Coriander seeds, half a dram;
Red candied sugar, half an ounce;
Boiling water, eight ounces.

Macerate in a close earthen vessel, which has not been vitrified with lead; stir the liquor now and then, and after it has stood four hours strain it. It may also be made with double, triple, &c. the quantity of senna.

This differs little from the former.

INFUSUM ROSÆ.

Lond.

Infusion of the Rose.

Take of

Red rose-buds, the heels being cut off, half an ounce;
Vitriolic acid, diluted, three drams;
Boiling distilled water, two pints and a half;
Double-refined sugar, one ounce and a half.

To the water, first poured on the petals in a glass vessel, add the diluted vitriolic acid, and macerate for half an hour. Strain the liquor when cold, and add the sugar.

This is used in active hœmorrhages as a restringent.

INFUSUM *vulgo* TINCTURA ROSARUM.

Edinb.

Infusion commonly called Tincture of Roses.

Take of

Red roses, dried, an ounce;
Boiling water, five pounds;
Vitriolic acid, one dram;
White sugar, two ounces.

Macerate the roses with the boiling water in an unglazed vessel four hours; then having poured on the acid, strain the liquor, and add the sugar.

INFUSUM RHEI.

Edin.

Infusion of Rhubarb.

Take of

Rhubarb, half an ounce;

Boiling water, eight ounces;
Spirituous cinnamon water, one ounce.

Macerate the rhubarb in a glass vessel with the boiling water for a night; then having added the cinnamon water, strain the liquor.

AQUA CALCIS.

Lond.

Lime Water.

Take of
Quicklime, half a pound;
Boiling distilled water, twelve pints.

Mix, and set it aside in a covered vessel for one hour; then pour off the liquor, which keep in a close vessel.

Edinb.

Take half a pound of fresh-burnt quicklime, put it into an earthen vessel, and gradually sprinkle upon it four ounces of water, keeping the vessel shut whilst the lime grows hot and falls into powder. Then pour upon it twelve pounds of water, and mix the lime thoroughly with the water by stirring. After the lime has subsided renew the stirring; and let this be done about ten times, always keeping the vessel shut (during the ebullition), that the access of the air may be the more effectually prevented. Lastly, let the water be filtered through paper placed in a funnel close shut at its top; and it must be kept in very close vessels.

Lime water is much used in a variety of cases with various success, both internally and externally, particularly when the disease is connected with a predominant acid, as happens often in the complaints of women and children, as diarrhœa, leucorrhœa, diabetes, &c. It is also a useful anthelmentic and lithontriptic. It is used to the quantity of a bottle or more a day. Externally it forms a wash for gleety sores.

ACETUM SCILLÆ.

Lond.

Vinegar of Squills.

Take of
Squills, fresh dried, one pound;
Vinegar, six pints;
Proof-spirit, half a pint.

Macerate the squills in the vinegar, with a gentle heat, in a glass vessel, for four-and-twenty hours; then press out the liquor, and set it by that the feces may subside: lastly, pour off the liquor, and add to it the spirit.

ACETUM SCILLITICUM.
Edin.
Squill Vinegar.

Take of
Dried root of squills, two ounces;
Distilled vinegar, two pounds and a half;
Rectified spirit of wine, three ounces.
Macerate the squills with the vinegar eight days; then press out the vinegar, to which add the spirit; and when the feces have subsided, pour out the clear liquor.

Is a powerful stimulant and expectorant in dropsical cases, and useful in pectoral complaints connected with a morbid secretion of viscid phlegm. It must be given in small doses.

ACETUM AROMATICUM.
Suec.
Aromatic Vinegar.

Take of
Tops of Rosemary,
Leaves of sage, each four ounces;
Flowers of lavender, two ounces;
Cloves, two drams;
Vinegar, eight pounds.
Macerate for four hours, express the liquor, and strain it.

Is chiefly used as an antiseptic for external application.

ACETUM ROSACEUM.
Suec.
Vinegar of Roses.

Take of
The flowers of red roses dried, any quantity; add to them twelve times their weight of vinegar.
Macerate for four days, and strain through paper.

Makes a useful external embrocation in head-ach.

ACETUM LITHARGYRI.
Suec.
Vinegar of Litharge.

Take of
Litharge, triturated, half a pound;
Vinegar, two pounds.
Digest them together frequently, stirring the mixture with a wooden rod, till the colour of blue paper be not changed by the vinegar; preserve for use the clear liquor which is above the sediment.

This is the same as the basis of Goulard's Lotion.

ACETUM COLCHICI,
Rofs.
Vinegar of Colchicum.

Take of
The recent root of colchicum cut in flices, one ounce;
Vinegar one pound.
Macerate with a gentle heat for two days; then ftrain after flight expreffion.

Is a ufeful diuretic and expectorant in dropfical cafes where the fquill is alfo proper.

INFUSUM KINKINÆ.
Suec.
Infufion of Peruvian Bark.

Take of
Peruvian bark, bruifed, an ounce and a half;
Spring water, boiling, a pound and an half.
Digeft for two hours, fhaking the veffel frequently; then ftrain the liquor with expreffion.

AQUA PICEA.
Tar Water.

Take of
Tar, two pounds;
Water, one gallon;
Stir them ftrongly together with a wooden rod; and after ftanding to fettle for twelve hours, pour off the water for ufe.

Tar water is now little ufed, and is only an impregnation of water with the vegetable acid.

DECOCTUM CATECHU.
Gen.
Decoction of Catechu.

Take of
Catechu, three drams;
Spring-water, two pounds.
Boil it to one pound; and add to the ftrained liquor,
Syrup of quinces, three ounces.

Powders.

The firft, or fimpleft of thefe forms is that of powders, and is appropriated only to thofe fubftances that are not too volatile or bulky, or whofe virtues require them to

be taken in ſubſtance. No ſubſtance, therefore, ſhould be given in the form of powder whoſe doſe exceeds half a dram, and the vehicle for taking them ſhould be a thin diluent with the lighter powders, and a thick or viſcid ſubſtance for the heavier or reſinous ones. In the preparation of powders the rules are a careful ſeparation of all the decayed or too rigid parts, the ſprinkling the dry aromatics with a few drops of water during the operation of pulverization, and drying in a ſufficient degree by a gentle heat the moiſter ones before it. The mixing difficultly pulveriſable ſubſtances, as the gums, &c. with thoſe that are eaſier reduced; and the making no ſeparation of any part, till the whole pulveriſation is completed. In the caſe of aromatics, preparing little at a time, or preſerving them when powdered cloſely ſtopt up, for ſome ſubſtances, though not volatile, have their virtues impaired when long expoſed to the air.

PULVIS ALOETICUS.

Lond.

Aloetic Powder.

Take of
  Socotorine aloes, one pound;
  White canella, three ounces.
Rub them ſeparately to powder, then mix them.

Is chiefly employed in the form of electuaries, pills, or tincture.

PULVIS ALOETICUS CUM FERRO.

Lond.

Aloetic Powder with Iron.

Take of
  Socotorine aloes, powdered, an ounce and an half;
  Myrrh, powdered, two ounces;
  Dry extract of gentian;
  Vitriolated iron, of each, in powder, one ounce.
Mix them.

This is alſo reduced commonly to the form of pills.

PULVIS ALOETICUS CUM GUAIACO.

Lond.

Aloetic Powder with Guaiacum.

Take of
Socotorine aloes, one ounce and an half;
Gum guaiacum, one ounce;
Aromatic powder, half an ounce.
Rub the aloes and gum guaiacum separately to powder; then mix all the ingredients together.

This is the basis of the pilulæ aromaticæ, and is a useful diaphoretic in small doses.

PULVIS AROMATICUS.

Lond.

Aromatic Powder.

Take of
Cinnamon, two ounces;
Smaller cardamom seeds, husked,
Ginger,
Long pepper, of each one ounce.
Rub them together to a powder.

Is useful in cold habits as a warm stomachic, from ten grains to half a dram.

PULVIS DIAROMATON, *sive* SPECIES AROMATICÆ.

Edin.

Aromatic Powder, or, Aromatic Species.

Take of
Nutmegs,
Lesser cardamom seeds,
Ginger, of each two ounces.
Beat them together into a powder, to be kept in a phial well shut.

PULVIS ASARI COMPOSITUS.

Lond.

Compound Powder of Asarabacca.

Take of
The dry leaves of asarabacca,
Sweet marjoram,
Syrian herb-mastich,
Dry flowers of lavender, of each one ounce.
Powder them together.

This is the preparation sold as herb snuff.

PULVIS STERNATORIUS, *sive* CEPHALICUS.

Edin.

Sternutatory, or *Cephalic Powder.*

Take of
The leaves of asarum, three parts;
Marjoram, one part.
Beat them together into a powder.

PULVIS e CERUSSA.

Lond.

Powder of Ceruss.

Take of
Cerusse, five ounces;
Sarcocol, one ounce and a half;
Tragacanth, half an ounce.
Rub them together into powder.

This is an external preparation employed in lotions and collyria.

PULVIS e CHELIS CANCRORUM COMPOSITUS.

Lond.

Compound Powder of Crabs Claw.

Take of
Crabs claws, prepared, one pound;
Chalk,
Red coral, each, prepared, three ounces.
Mix them.

This is a simple absorbent powder.

PULVIS CONTRAYERVÆ COMPOSITUS.

Lond.

Compound Powder of Contrayerva.

Take of
Contrayerva, powdered, five ounces;
Compound powder of crabs claws, one pound and an half.
Mix them.

This owes its virtues entirely to the contrayerva.

PULVIS e CRETÆ COMPOSITUS.

Lond.

Compound Powder of Chalk.

Take of
Prepared chalk, half a pound,
Cinnamon, four ounces;
Tormentil,
Gum arabic, of each, three ounces;

Long pepper, half an ounce.
Powder them feparately, and mix them.

PULVIS CRETACEUS.
Edin.
Chalk Powder.

Take of
White chalk prepared, four ounces;
Nutmeg, half a dram;
Cinnamon, one dram.
Mix and make them into a powder; which may fupply the place of the cardialgic troches.

The junction of the aromatics renders this a ufeful medicine in weaknefs of ftomach and diarrhœa from an acrid caufe.

PULVIS e CRETA COMPOSITUS CUM OPIO.
Lond.
Compound Powder of Chalk with Opium.

Take of
Compound powder of chalk, eight ounces;
Hard purified opium, powdered, one dram and an half.
Mix them.

This renders the above ftill more powerful.

PULVIS IPECACUANHÆ COMPOSITUS.
Lond.
Compound Powder of Ipecacuanha.

Take of
Ipecacuanha,
Hard purified opium, of each, powdered, one dram;
Vitriolated kali, powdered, one ounce.
Mix them.

This is a certain fudorific in rheumatifm, dropfy, and other difeafes, in a dofe of from five to twelve grains, avoiding drink for fome time after it.

PULVIS SUDORIFICUS, *five* DOVERI.
Edin.
Sudorific, or Dover's Powder.

Take of
Vitriolated tartar, three drams;
Opium,
Root of ipecacuanha, beat, of each one fcruple.
Mix, and grind them accurately together, fo as to make an uniform powder.

This in ten or twelve grains is even more certain than the former.

PULVIS *e* JALAPA COMPOSITUS.
Edin.
Compound Powder of Jalap.

Take of
Jalap root, two ounces;
Crystals of tartar, two ounces.
Mix, and diligently grind them together for some time, so as to form a very fine powder.

This is an active purgative.

PULVIS *e* MYRRHA COMPOSITUS.
Lond.
Compound Powder of Myrrh.

Take of
Myrrh,
Dried savin,
rue,
Russian castor, of each one ounce.
Rub them together into a powder.

This is celebrated against uterine obstructions from one scruple to a dram thrice a day.

PULVIS OPIATUS.
Lond.
Opiate Powder.

Take of
Hard purified opium, powdered, one dram;
Burnt and prepared hartshorn, nine drams.
Mix them.

This is a sweating powder, ten grains of it contain one of opium.

PULVIS *e* SCAMMONIO COMPOSITUS.
Lond.
Compound Powder of Scammony.

Take of
Scammony,
Hard extract of jalap, of each two ounces;
Ginger, half an ounce.
Powder them separately, and mix them.

Edinb.

Take of
Scammony,

Cryſtals of tartar, of each two ounces.
Mix, and grind them diligently into a powder.

PULVIS *e* SCAMMONIO CUM ALOE.

Lond.

Powder of Scammony with Aloes.

Take of
Scammony, ſix drams;
Hard extract of jalap,
Socotorine aloes, of each an ounce and an half;
Ginger, half an ounce.
Powder them ſeparately, and mix them.

This is a more active purgative than the former. From five to ten grains are its doſe.

PULVIS *e* SCAMMONIO CUM CALOMELANE.

Lond.

Powder of Scammony with Calomel.

Take of
Scammony, half an ounce;
Calomel,
Double-refined ſugar, of each two drams.
Rub them ſeparately to a powder, and then mix them.

This is more ſuited to obſtinate coſtiveneſs and dropſical caſes.

PULVIS *e* SENNA COMPOSITUS.

Lond.

Compound Powder of Senna.

Take of
Senna,
Cryſtals of tartar, of each two ounces;
Scammony, half an ounce;
Ginger, two drams.
Rub the ſcammony by itſelf, rub the reſt together into a powder, and then mix them all.

Two ſcruples to a dram are the doſe of this powder.

PULVIS STYPTICUS.

Edin.

Styptic Powder.

Take of
Alum, an ounce and a half;

Gum kino, three drams.
Grind them together into a fine powder.

This is a powerful aſtringent in uterine hœmorrhages.

PULVIS e TRAGACANTHA COMPOSITUS.

Lond.

Compound Powder of Tragacanth.

Take of
Tragacanth, powdered,
Gum Arabic,
Starch, of each an ounce and half.
Double-refined ſugar, three ounces.
Rub them together into a powder.

This is a mild demulcent in pectoral and alvine complaints, in a doſe of half a dram to three drams.

PULVIS ANTHELMINTICUS.

Gen.

Anthelmintic Powders.

Take of
The flowers of tanſy,
Worm-ſeed, each three drams;
Sal martis, one dram.
Mix them.

Half a dram of this powder is a doſe.

PULVIS ANTILYSSUS.

Brun.

Powder againſt the Bite of a Mad Dog.

Take of
Aſh-coloured ground liverwort, two ounces;
Black pepper, one ounce.
Beat them together into a powder.

PULVIS ARI COMPOSITUS.

Suec.

Compound Powder of Arum.

Take of
Arum root, freſh dried, two drams;
Yellow water-flag roots,
Burnet ſaxifrage roots, each one dram;
Canella alba, a dram;
Salt of wormwood, one ſcruple.
Beat them into a powder, which is to be kept in a cloſe veſſel.

PULVIS DIGESTIVUS.

Suec.

Digestive Powder.

Take of
Bitter purging salts,
Rhubarb, each equal parts.
Mix them.

This is a good stomachic and evacuant.

PULVIS DYSENTERICUS.

Dan.

Dysenteric Powder.

Take of
Rhubarb, one ounce;
Calcined hartshorn, half an ounce;
Gum Arabic, three drams;
Cascarilla bark, two drams.
Mix them, and reduce them to a very fine powder.

This is only suited to the passive stage of dysentery.

PULVIS FUMALIS.

Ross.

Fumigation Powder.

Take of
Olibanum,
Amber,
Mastich, each three parts;
Storax, two parts;
Benzoine,
Labdanum, each one part.
Mix them into a gross powder.

This is only used for the purposes of fumigation.

PULVIS INFANTUM.

Suec.

Powder for Infants.

Take of
Magnesia alba, one ounce;
Rhubarb, reduced to a very fine powder, one dram.
Let them be mixed.

This is suited to correct the ascescent state of the stomach and bowels of infants.

PULVIS NITROSUS.

Suec.

Nitrous Powder.

Take of
Purified nitre, three ounces;
Salt of ſorrel, one ounce;
Double refined ſugar, ten ounces.
Let them be mixed.

This is a good mode of exhibiting nitre.

PULVIS PERUVIANUS PURGANS.

Gen.

Purging Peruvian Powder.

Take of
The powder of Peruvian bark, one ounce;
Powder of rhubarb,
ſal ammoniac, each one dram and a half.

This form prevents the coſtive tendency of the bark.

PULVIS SEDATIVUS.

Suec.

Sedative Powder.

Take of
Opium, half a ſcruple;
Purified nitre, five ſcruples and a half;
Refined ſugar, one ounce.

PULVIS E SPONGIA.

Gen.

Sponge Powder.

Take of
Burnt ſponge, powdered,
Common ſalt, each three drams.
Mix them, and divide into twelve powders.

This is uſed in ſcrofulous caſes.

Troches.

Troches are powders made up with glutinous ſubſtances, a form chiefly intended to allow medicines to diſſolve ſlowly in the mouth. The ſame rules are to be obſerved here as in making powders which is the previous ſtep. In forming them, the hands are to be anointed with oil, or ſprinkled with ſtarch or liquorice powder, to prevent adheſion. When formed, they ſhould

be dried in an airy place on an inverted ſieve, and frequently turned.

TROCHISCI AMYLI.

Lond.

Troches of Starch.

Take of
Starch, an ounce and a half;
Liquorice, ſix drams;
Florentine orris, half an ounce;
Double-refined ſugar, one pound and a half.

Rub theſe to powder, and, by the help of tragacanth, diſſolved in water, make troches.

They may be made, if ſo choſen, without the orris.

TROCHISCI BECHICI ALBA.

Edin.

White Pectoral Troches

Take of
Pureſt ſugar, one pound;
Gum Arabic, four ounces;
Starch, one ounce;
Flowers of benzoin half a dram.

Having beat them all into a powder, make them into a proper maſs with roſe-water, ſo as to form troches.

TROCHISCI GLYCYRRHIZÆ.

Lond.

Troches of Liquorice.

Take of
Extract of liquorice,
Double refined ſugar, of each ten ounces;
Tragacanth, powdered, three ounces.

Make troches by adding water.

TROCHISCI BECHICI NIGRI.

Edin.

Black Pectoral Troches.

Take of
Extract of liquorice,
Gum Arabic, each four ounces;
White ſugar, eight ounces.

Diſſolve them in warm water, and ſtrain; then evaporate the mixture over a gentle fire till it be of a proper conſiſtence for being formed into troches.

TROCHISCI BECHICI *cum* OPIO.

Edin.

Pectoral Troches with Opium.

Take of
Pure opium, two drams;
Balsam of Peru, one dram,
Tincture of Tolu, three drams.
Grind the opium with the balsam and tincture previously mixed, till it be thoroughly dissolved, then add by degrees,
Of
Common syrup, eight ounces,
Extract of liquorice, softened in warm water, five ounces.
Whilst beating them diligently, gradually sprinkle upon the mixture five ounces of powdered gum Arabic. Exsiccate so as to form troches, each weighing ten grains.

TROCHISCI *e* NITRO.

Lond.

Troches of Nitre.

Take of
Purified nitre, powdered, four ounces;
Double-refined sugar, powdered, one pound;
Tragacanth, powdered, six ounces.
With the addition of water, make troches.

TROCHISCI *e* NITRO.

Edin.

Troches of Nitre.

Take of
Nitre purified, three ounces;
Double refined sugar, nine ounces.
Make them into troches with mucilage of gum tragacanth.

TROCHISCI *e* SULPHURE.

Lond.

Troches of Sulphur.

Take of
Washed flowers of sulphur, two ounces,
Double-refined sugar, four ounces
Rub them together, and, with the mucilage of quince-seeds, now and then added make troches

TROCHISCI *e* SULPHURE, *sive* DIASULPHURIS.

Edin.

Troches of Sulphur.

Take of
Flowers of sulphur, two ounces,

Flowers of benzoine, one ſcruple;
White ſugar, four ounces;
Factitious cinnabar, half a dram.

Beat them together, and add mucilage of gum tragacanth as much as is ſufficient

Mix and make them into troches according to art.

TROCHISCI e CRETA.

Lond.

Troches of Chalk.

Take of
Chalk, prepared, four ounces;
Crabs-claws, prepared, two ounces;
Cinnamon, half an ounce;
Double-refined ſugar, three ounces.

Theſe being rubbed to powder, add the mucilage of gum Arabic, and make troches.

TROCHISCI e MAGNESIA.

Lond.

Troches of Magneſia.

Take of
Burnt magneſia, four ounces;
Double-refined ſugar, two ounces;
Ginger, powdered, one ſcruple.

With the addition of the mucilage of gum Arabic make troches.

TROCHISCI de MINIO.

Dan.

Red Lead Troches.

Take of
Red lead, half an ounce;
Corroſive mercury ſublimate, one ounce;
Crumb of the fineſt bread, four ounces.

Make them up with roſe water into oblong troches.

TROCHISCI CATECHU.

Brun

Troches of Catechu.

Take of
Catechu, one ounce;
White ſugar candy, two ounces;
Ambergris,
Muſk, each ten grains;
Mucilage of gum tragacanth, as much as is ſufficient.

Make them into troches.

Pills.

Medicines of a ſmall doſe and offenſive ſmell and taſte, are eaſily adapted to this form. From its difficult ſolution, the medical effects of this form are the moſt laſting, and where this is not wanted, reſins and ſaponaceous ſubſtitutes ſhould be joined with them to increaſe their ſolubility. Light dry powders are made up in this form, with mucilages or ſyrups; gums, or reſins, with ſpirit of wine; ponderous ſubſtances with honey, conſerves, or extracts.

The rules for the formation of pills are, to obſerve the ſame previous ſteps as in the preparation of powders. In the junction of reſins, gums, or extracts, they are to be ſeverally ſoftened to powder, then added, and the whole beat together till fully mixed. The maſſes ſhould afterwards be kept in bladders, moiſtened occaſionally with ſome of the preparing ſolvent.

PILULÆ ÆTHIOPICÆ.

Edin.

Ethiopic Pills.

Take of
Quickſilver, ſix drams;
Golden ſulphur of antimony,
Reſin of guaiacum,
Honey, each half an ounce.

Grind the quickſilver with the honey, in a glaſs mortar, until the mercurial globules entirely diſappear; then add the golden ſulphur and guaiacum, with as much mucilage of gum Arabic as is ſufficient to make the mixture into a maſs of the proper conſiſtence for forming pills.

They are an uſeful alterative both in cutaneous and venereal diſorders. One fourth part of the quantity above preſcribed may be made into ſixty pills; of which, from one to four may be taken every night and morning, the patient keeping moderately warm during the whole time that this courſe is continued.

PILULÆ *ex* ALOE.

Lond.

Pills of Aloes.

Take of
Socotorine aloes, powdered, one ounce;

Extract of gentian, half an ounce;
Syrup of ginger, as much as is sufficient.
Beat them together.

PILULÆ ALOETICÆ.
Edinb.
Aloetic Pills.

Take of
Socotorine aloes, in powder,
Thick extract of gentian, each two ounces.
Make them into a mafs with fimple fyrup.

Thefe pills have been much ufed as warming and ftomachic laxatives: they are very well fuited for the coftivenefs fo often attendant on people of fedentary lives.

PILULÆ *ex* ALOE CUM MYRRHÆ.
Lond.
Pills of Aloes with Myrrh.

Take of
Socotorine aloes, two ounces;
Myrrh,
Saffron, of each one ounce;
Syrup of faffron, as much as is fufficient.
Rub the aloes and myrrh feparately to powder; afterwards beat them all together.

PILULÆ COMMUNES, *vulgo* RUFI.
Edin.
The Common Pills, vulgarly called *Rufus's Pills.*

Take of
Socotorine aloes, two ounces;
Myrrh, one ounce;
Saffron, half an ounce.
Beat them into a mafs with a proper quantity of fyrup.

Thefe pills, given to the quantity of half a dram or two fcruples, prove confiderably cathartic, but they anfwer much better purpofes in fmaller dofes as laxatives or alteratives.

PILULÆ *ex* COLOCYNTHIDE *cum* ALOE, *vulgo* PILULÆ COCCIÆ.
Colocynth Pills with Aloes, commonly called *Cocciæ.*
Edin.

Take of
Socotorine aloes,

Scammony, of each two ounces;
Sal polychrest, two drams;
Colocynth, one ounce;
Oil of cloves, two drams.

Reduce the aloes and scammony into a powder with the salt; then let the colocynth, beat into a very fine powder, and the oil be added; lastly, make it into a proper mass with mucilage of gum Arabic.

These pills often produce a copious discharge in cases of obstinate costiveness, when taken to the extent only of five or ten grains; but they may be employed in much larger doses.

PILULÆ *e* CUPRO.

Edinb.

Copper Pills.

Take of
Cuprum ammoniacum, sixteen grains;
Crumb of bread, four scruples;
Spirit of sal ammoniac, as much as is sufficient to form them into a mass, which is to be divided into thirty-two equal pills.

Each of these pills weighs about three grains, and contains somewhat more than half a grain of the cuprum ammoniacum.

PILULÆ *e* GUMMI.

Lond.

Gum Pills.

Take of
Galbanum,
Opopanax,
Myrrh,
Sagapenum, of each one ounce;
Asafœtida, half an ounce;
Syrup of saffron, as much as is sufficient.

Beat them together.

PILULÆ GUMMOSÆ.

Edinb.

Gum Pills.

Take of
Asafœtida,
Galbanum,
Myrrh, each one ounce;
Rectified oil of amber, one dram.

Beat them into a mass with simple syrup.

These pills are designed as antihysterics and emmenagoes, and are very well calculated for answering those intentions; half a scruple, a scruple, or more, may be taken every night or oftener.

PILULÆ *ex* HYDRARGYRO.

Lond.

Quickfilver Pills.

Take of

Purified quickfilver,

Extract of liquorice, having the confiftence of honey, of each two drams,

Liquorice, finely powdered, one dram.

Rub the quickfilver with the extract of liquorice until the globules difappear; then, adding the liquorice-powder, mix them together.

PILULÆ *e* HYDRARGYRO, *five* MERCURIALES.

Edinb.

Mercurial Pills.

Take of

Quickfilver,

Honey, each one ounce:

Crumb of bread, two ounces,

Grind the quickfilver with the honey in a glafs mortar till the globules difappear, adding occafionally a little fimple fyrup; then add the crumb of bread, and beat the whole with water into a mafs, which is to be immediately divided into four hundred and eighty equal pills.

The mercurial pill is one of the beft preparations of mercury, and may in general fuperfede moft other forms of this medicine. The dofe of the pills is from two to four or fix in the day, according to the effects we wifh to produce.

PILULÆ *e* JALAPPA.

Edin.

Jalap Pills.

Take of

Extract of jalap, two ounces;

Aromatic powder, half an ounce.

Beat them into a mafs with fimple fyrup.

This is an ufeful and active purgative, either for evacuating the contents of the inteftinal canal, or producing a difcharge from the fyftem in general.

PILULÆ PLUMMERI.

Edinb.

Plumer's Pill.

Take of
- Sweet mercury,
- Precipitated fulphur of antimony, each fix drams;
- Extract of gentian,
- White Spanifh foap, each two drams.

Let the mercury be triturated with the fulphur till they be thoroughly mixed, then add the extract, and form a mafs with fimple fyrup.

This is a ufeful alterative in five or ten grains twice a day.

PILULÆ *ex* OPIO.

Lond.

Opium Pills.

Take of
- Hard purified opium, powdered, two drams;
- Extract of liquorice, one ounce.

Beat them until they are perfectly united.

PILULÆ THEBAICÆ, *vulgo* PACIFICÆ.

Edinb.

Thebaic, commonly called *Pacific Pills.*

Take of
- Opium, half an ounce;
- Extract of liquorice, two ounces;
- Caftile foap, an ounce and a half;
- Jamaica pepper, one ounce.

Soften the opium and extract feparately with proof-fpirit, and having beat them into a pulp, mix them; then add the foap, and the pepper beat into a powder; and laftly, having beat them well together form the whole into a mafs.

The firft is a fimple opiate, in which every five grains of the mafs contains one of opium; and on the opium alone can we fuppofe that the activity of the medicine depends. Nine grains of the compofition contain nearly one of opium.

PILULÆ *e* SCILLA.

Lond.

Squill Pills.

Take of
- Frefh dried fquill, powdered, one dram;
- Ginger, powdered,

Soap, of each three drams;
Ammoniacum, two drams;
Syrup of ginger as much as is sufficient.
Beat them together.

PILULÆ SCILLITICÆ.

Edinb.

Squill Pills.

Take of
Gum ammoniac,
Lesser cardamon seeds, in powder,
Extract of liquorice, each one dram;
Dried root of squills, in fine powder, one scruple.
Mix, and form them into a mass with simple syrup.

These are elegant and commodious forms for the exhibition of squills.

PILULÆ STOMACHICÆ.

Edinb.

Stomachic Pills.

Take of
Rhubarb, one ounce;
Succotorine aloes, six drams;
Myrrh, half an ounce;
Vitriolated tartar, one dram;
Essential oil of mint, half a dram;
Syrup of orange peel, a sufficient quantity.
Make them into a mass.

A scruple of the mass may be taken twice a day.

PILULÆ BACHERI.

Gen.

Bacher's Pill.

Take of
Extract of black hellebore,
Purified myrrh, each one ounce;
Powder of carduus benedictus, two scruples.
Mix them into a mass according to art, to be dried in the air till it be fit for the formation of pills, each weighing one grain.

The dose is varied according to circumstances, from one to thirty pills being taken in the course of the day.

PILULÆ *ex* ELATERIO.

Suec.

Pills of Elaterium.

Take of
The pureſt gum ammoniac, two ounces,
Socotorine aloes,
Gamboge, each two drams;
Elaterium, half a dram.
Mix them, by means of bitter tincture, into a maſs for the formation of pills, each weighing two grains.

This, as well as the former, is alſo a pill celebrated for the cure of dropſical affections: and when each pill is made to contain half a grain of the elaterium, the doſe may be eaſily accommodated to the circumſtances of the patient, one or two pills being taken every hour till they begin to operate.

PILULÆ FOETIDÆ.

Suec.

Fœtid Pills.

Take of
Aſafœtida,
Caſtor, each a dram and a half;
Salt of amber, half a dram;
Oil of hartſhorn, half a ſcruple.
Make them into a maſs, with tincture of myrrh, to be divided into pills of two grains each.

This is a uſeful nervous medicine in hyſterical caſes.

PILULÆ *de* GAMBOGIA.

Dan.

Gamboge Pills.

Take of
Socotorine aloes,
Extract of black hellebore,
Sweet mercury,
Gamboge, each two drams;
Diſtilled oil of juniper, half a dram;
Syrup of buckthorne, as much as is ſufficient for forming a maſs of pills.

It is not improbable that the eſſential oil of juniper may in ſome degree operate as a corrigent.

PILULÆ e MERCURIO CORROSIVO ALBO.

Suec.

Pills of corrosive sublimate Mercury.

Take of

Corrosive sublimate,
Purified sal ammoniac, each one scruple;
Distilled water, as much as is sufficient to melt them;
Powder of the root of althea, sixteen scruples;
Honey, two drams.

Mix them into a mass for the formation of pills, each weighing three grains.

Each of the pills contains about an eighth of a grain of the corrosive; thus the dose may be easily regulated according to the intention in view.

PILULÆ PICEÆ.

Dan.

Tar Pills.

Take any quantity of tar, and mix with it as much powdered elecampane root as will reduce it to a proper thickness for being formed into pills.

Half a dram of the mass, made into middle-sized pills, is given every morning and evening in disorders of the breast, scurvies, &c.

PILULÆ SAPONACEÆ.

Suec.

Soap Pills.

Take of

Hard white soap, two ounces;
Extract of birch, one ounce.

Let them be formed into a mass, to be divided into pills, each containing three grains.

This article, even when taken in small quantity with some constitutions, operates as a gentle laxative.

PILULÆ e STYRACE.

Suec.

Storax Pills.

Take of

Strained storax, five scruples;
Extract of liquorice, three drams;
Opium, one dram.

Let the opium, dissolved in wine, be added to the other ingredients, so as to form a mass of proper consistence, to be made into pills, each weighing three grains.

One grain of opium is contained in six grains of the mass.

Electuaries.

Electuaries consist generally of mild alterative powders mixed with syrup to a middling consistence, so as to admit of being easily swallowed. In making them, the proportion of honey is thrice the weight of the powder, or of syrup about twice the weight; and, to prevent the drying nature of the powder, a little conserve should be added, to preserve the composition moist.

Where the medicine is of the less agreeable kind, mucilage, instead of syrup, is occasionally employed, from being less adhesive; and it is rendered more palliative in this form by the addition of the liquorice extract. The dose of this form of medicine varies, according to its nature, from the size of a nutmeg to two or three ounces.

In the preparation for electuaries the rules respecting decoctions and powders will apply, preparatory to the ingredients being mixed. Substances entering this composition, and not pulverisable, should be first dissolved, and then the ingredients slowly added, till the whole is reduced to a uniform mass. Pulpy and astringent substances should in this form be prepared only in small quantity at a time, and their superfluous moisture exhaled before being mixed. Where such compositions dry, they may be restored to a fit consistence, by being mixed up with some sweet wine.

ELECTUARIUM e CASSIA.

Lond.

Electuary of Cassia.

Take of

The fresh extracted pulp of cassia, half a pound;
Manna, two ounces;
Pulp of tamarinds, one ounce;
Rose-syrup, half a pound.

Beat the manna, and dissolve it over a slow fire in the rose-syrup; then add the pulps; and, with a continued heat, evaporate the whole to the proper thickness of an electuary.

ELECTUARIUM *e* CASSIA, *vulgo* DIACASSIA. *Edinb.*

Electuary of Cassia, commonly called *Diacassia.*

Take of
Pulp of cassia fistularis, six ounces;
Pulp of tamarinds,
Manna, each an ounce and a half;
Syrup of pale roses, six ounces;

Having beat the manna in a mortar, dissolve it with a gentle heat in the syrup; then add the pulps, and evaporate them with a regularly continued heat to the consistence of an electuary.

They are usefully taken by themselves, to the quantity of two or three drams occasionally, for gently loosening the belly in costive habits.

ELECTUARIUM *e* SCAMMONIO. *Lond.*

Electuary of Scammony.

Take of
Scammony, in powder, one ounce and an half;
Cloves,
Ginger, of each six drams;
Essential oil of caraway, half a dram;
Syrup of roses, as much as is sufficient.

Mix the spices, powdered together, with the syrup; then add the scammony, and lastly the oil of caraway.

A dram and half of this, which contains fifteen grains of scammony, is equivalent to half an ounce of the other.

ELECTUARIUM *e* SENNA. *Lond.*

Electuary of Senna.

Take of
Senna, eight ounces;
Figs, one pound;
Pulp of tamarinds,
—— of cassia,
—— of prunes, of each half a pound;
Coriander-seeds, four ounces;
Liquorice, three ounces;
Double-refined sugar, two pounds and an half.

Powder the ſenna with the coriander-ſeeds, and ſift out ten ounces of the mixt powder. Boil the remainder with the figs and liquorice, in four pints of diſtilled water, to one half; then preſs out and ſtrain the liquor. Evaporate this ſtrained liquor to the weight of about a pound and an half; then add the ſugar, and make a ſyrup; add this ſyrup by degrees to the pulps, and laſtly mix in the powder.

ELECTUARIUM LENITIVUM.

Edinb.

Lenitive Electuary.

Take of

Pulp of French prunes, one pound;
Pulp of caſſia,
Pulp of tamarinds, each two ounces and a half;
Black ſyrup of ſugar, commonly called molaſſes, one pound and a half;
Senna leaves in fine powder, four ounces.
Coriander ſeeds in fine powder, half an ounce.

Having boiled the pulps with the ſyrup to the conſiſtence of honey, add the powders, and beat the whole into an electuary.

This electuary is a very convenient laxative, and has long been in common uſe among practitioners. Taken to the quantity of a nutmeg, or more, as occaſion may require.

ELECTUARIUM JAPONICUM, *vulgo* CONFECTIO JAPONICA.

Edinb.

Japonic Electuary, commonly called *Japonic Confection.*

Take of

Japan earth, four ounces;
Gum kino, three ounces;
Cinnamon,
Nutmeg, each one ounce;
Opium diffuſed in a ſufficient quantity of Spaniſh white wine, one dram and a half;
Syrup of dried roſes boiled to the conſiſtence of honey, two pounds and a quarter.

Mix, and form them into an electuary.

ELECTUARIUM JOVIALE.

Brun.

Tin Electuary.

Take of

Pure tin,
Quickſilver, each one ounce.

Let them be formed into an amalgam; then add
Oyster shells, prepared, one ounce.
Reduce the whole to a powder.
Take of
This powder,
Conserve of wormwood, each one ounce, and form an electuary with syrup of mint.

It may be taken twice a day, to the extent of two or three drams for a dose.

ELECTUARIUM GINGIVALE.

Suec.

Electuary for the Gums.

Take of
Powdered myrrh, three drams;
Cream of tartar,
Cochineal, each a dram and a half.
Grind them together in a glass mortar; then add
Melted honey, four ounces;
Cloves, in powder, one dram.

Myrrh, particularly under the form of tincture, has long been a favourite application to the gums, when in a spongy or ulcerated state.

ELECTUARIUM e MANNA.

Suec.

Electuary of Manna.

Take of
Manna,
Refined sugar, pounded,
Fennel-water, each two ounces.
Strain the mixture, using expression; then add
Fine powder of the root of florentine orrice, one dram;
Fresh drawn almond oil, one ounce.

In this electuary we have a gentle emollient laxative, which is very useful in these cases, where constipation either arises from indurated feces, or is supported by that cause.

ELECTUARIUM NITROSUM.

Gen.

Nitrous Electuary.

Take of
Purified nitre, half an ounce;

Conferve of rofes, four ounces.
Mix them.

Under this formula nitre may be introduced to a confiderable extent, without giving uneafinefs at the ftomach, while at the fame time its refrigerant power is combined with the aftringency of the rofes.

ELECTUARIUM TEREBINTHINATUM.
Suec.
Terebinthinate Electuary.

Take of
Spirit of turpentine, half an ounce;
Honey, one ounce;
Powder of liquorice, as much as is fufficient for the formation of an electuary.

It has been efpecially celebrated for the cure of obftinate rheumatifms, and above all, for that modification of rheumatifm which has the name of *ifchias*, and which is found, in many inftances, obftinately to refift other modes of cure.

LINCTUS LENIENS.
Suec.
Lenient Linctus.

Take of
Gum arabic, bruifed, two drams;
Cherry water, half an ounce.
By trituration in a mortar, mix with them
Almond oil, frefh drawn,
Syrup of almonds, each feven ounces.

It may be taken at pleafure to any extent that the ftomach will eafily bear.

Confections.

This form differs nothing from the former but in poffeffing fomewhat more confiftence.

CONFECTIO AROMATICA.
Lond.
Aromatic Confection.

Take of
Zedoary, in coarfe powder,
Saffron, of each half an ounce;
Diftilled water, three pints.

Macerate for twenty-four hours; then press and strain. Reduce the strained liquor, by evaporation to a pint and a half, to which add the following, rubbed to a very fine powder:

Compound powder of crabs-claws, sixteen ounces;
Cinnamon,
Nutmegs, of each two ounces;
Cloves, one ounce;
Smaller cardamom-seeds, husked, half an ounce;
Double-refined sugar, two pounds.

Make a confection.

This confection, as now reformed, is a sufficiently grateful and moderately warm cordial; and frequently given with that intention, from eight or ten grains to a scruple or upwards, in boluses and draughts.

ELECTUARIUM CARDIACUM, *vulgo* CONFECTIO CARDIACA.

Edinb.

Cordial Electuary, commonly called *Cordial Confection.*

Take of
Conserve of orange-peel, three ounces;
Preserved nutmegs, an ounce and an half;
Preserved ginger, six drams;
Cinnamon, in fine powder, half an ounce;
Syrup of orange-peel, as much as will form the whole into an electuary.

We therefore consider this preparation as an useful remedy for the purposes expressed in its title.

CONFECTIO OPIATA.

Lond.

Confection of Opium.

Take of
Hard purified opium, powdered, six drams;
Long pepper,
Ginger,
Caraway seeds, of each two ounces;
Syrup of white poppy, boiled to the consistence of honey, three times the weight of the whole.

Mix the purified opium carefully with the heated syrup: then add the rest, rubbed to powder.

ELECTUARIUM THEBAICUM.

Edin.

Thebaic Electuary.

Take of
Powder of aromatics, six ounces;

Virginian ſnake-root, in fine powder, three ounces;
Opium, diffuſed in a ſufficient quantity of Spaniſh white-wine, three drams;
Clarified honey, thrice the weight of the powders.
Mix them, and form an electuary.

With regard to the quantity of opium in the foregoing compoſitions, one grain of it is contained in thirty-ſix grains of the confectio opiata, and in five ſcruples of the Thebaic electuary.

Syrups.

Syrups are ſolutions of ſugar in ſimple water, or in watery and vinous infuſions, and they are chiefly now employed as vehicles for medicines of greater efficacy, few of them being preſcribed as medicines themſelves. In making ſyrups the general rule is to uſe 29 ounces of ſugar to one pint of liquor, diſſolving it in the liquor in a water-bath; and, being ſet aſide for 24 hours it is to be ſcummed, and the ſyrup poured off from the ſediment.

The ſame rules are proper here as laid down for the ſimple decoctions, and the pureſt ſugar ſhould only be employed in making the ſyrup. The proportion uſed ſhould be as much as the liquor can keep diſſolved when cold, unleſs otherwiſe ordered. The veſſel for making it ſhould be well tinned, and the ſyrup when made ſet by till next day, and then the ſaccharine cruſt removed from it.

SYRUPUS ACETI.
Edin.
Syrup of Vinegar.

Take of
Vinegar, two pounds and an half;
Refined ſugar, three pounds and an half:
Boil them till a ſyrup be formed.

This is to be conſidered as ſimple ſyrup merely acidulated, and is by no means unpleaſant.

SYRUPUS ALTHÆÆ.
Lond.
Syrup of Marſhmallows.

Take of
Freſh root of marſhmallow, bruiſed, one pound;

Double refined fugar, four pounds;
Diftilled water, one gallon.

Boil the water with the marfhmallow root to one half, and prefs out the liquor when cold. Set it by twelve hours; and after the feces have fubfided, pour off the liquor. Add the fugar, and boil it to the weight of fix pounds.

Edin.

Take of
Marfhmallow roots, fomewhat dried, nine ounces;
Water, ten pounds;
Pureft fugar, four pounds.

Boil the water with the roots to the confumption of one half, and ftrain the liquor, ftrongly expreffing it. Suffer the ftrained liquor to reft till the feces have fubfided; and when it is free of the dregs, add the fugar; then boil fo as to make a fyrup.

It is ufed chiefly in nephritic cafes, for fweetening emollient decoctions, and the like: of itfelf it can do little fervice, notwithftanding the high opinion which fome have entertained of it.

SYRUPUS CARYOPHYLLI RUBRI.

Lond.

Syrup of Clove July-Flower.

Take of
Frefh clove July flowers, the heels being cut off, two pounds;
Boiling diftilled water, fix pints.

Macerate the flowers for twelve hours in a glafs veffel; and, in the ftrained liquor, diffolve the double-refined fugar, that it may be made a fyrup.

SYRUPUS CARYOPHYLLORUM.

Edin.

Syrups of Clove July-Flower.

Take of
Clove July-flowers, frefh gathered and freed from the heels, one pounds;
Pureft fugar, feven pounds and a quarter;
Boiling water, four pounds.

Macerate the flowers in the water for a night; then to the ftrained liquor add the fugar previoufly beat, and diffolve it by a gentle heat, to make the whole into a fyrup.

This fyrup is of an agreeable flavour, and of a fine red colour; and for thefe it is chiefly valued.

SYRUPUS COLCHICI.
Edin.
Syrup of Colchicum.

Take of
Colchicum root, fresh and succulent, cut into small pieces, one ounce;
Vinegar, sixteen ounces;
Purest sugar, twenty-six ounces.
Macerate the root in the vinegar two days, now and then shaking the vessel; then strain it with a gentle pressure. To the strained liquor add the sugar, and boil a little so as to form a syrup.

The syrup of colchicum is often successfully employed as a diuretic, and may be taken from a dram or two to the extent of an ounce or more.

SYRUPUS CORTICIS AURANTII.
Lond.
Syrup of Orange-peel.

Take of
Fresh outer-rind of Seville oranges, eight ounces;
Boiling distilled water, five pints.
Macerate for twelve hours in a close vessel; and, in the strained liquor, dissolve the double-refined sugar to make a syrup.

Edin.

Take of
Yellow rind of Seville orange-peel, fresh, six ounces;
Boiling water, three pounds.
Infuse them for a night in a close vessel; then strain the liquor; let it stand to settle; and having poured it off clear from the sediment, dissolve in it four pounds and a quarter of white sugar, so as to make it into a syrup with a gentle heat.

In making this syrup it is particularly necessary that the sugar be previously powdered, and dissolved in the infusion with as gentle a heat as possible, to prevent the exhalation of the volatile parts of the peel.

SYRUPUS CROCI.
Lond.
Syrup of Saffron.

Take of
Saffron, one ounce;
Boiling distilled water, one pint.
Macerate the saffron in the water, for twelve hours, in a close vessel; and dissolve the double-refined sugar in the strained liquor that it may be made a syrup.

This ſyrup is at preſent frequently preſcribed; it is a pleaſant cordial, and gives a fine colour to juleps.

SYRUPUS SUCCI LIMONIS.

Lond.

Syrup of Lemon-juice.

Take of
- Lemon-juice, ſtrained, after the feces have ſubſided, two pints;
- Double-refined ſugar, fifty ounces.

Diſſolve the ſugar, that it may be made a ſyrup.

SYRUPUS e SUCCO MALORUM LIMONIORUM.

Edin.

Syrup of Lemon-juice.

Take of
- Juice of lemons, ſuffered to ſtand till the feces have ſubſided, and afterwards ſtrained, two pounds and a half.
- Double refined ſugar, fifty ounces.

Diſſolve the ſugar in the juice, ſo as to make a ſyrup thereof.

SYRUPUS FRUCTUS MORI.

Lond.

Syrup of the Juice of Mulberries.

SYRUPUS FRUCTUS RUBI IDÆI.

Lond.

Syrup of the Juice of Raſpberries.

SYRUPUS FRUCTUS RIBIS NIGRI.

Lond.

Syrup of Black Currants.

Theſe three are directed by the London college to be prepared in the ſame manner as ſyrup of lemons, which immediately precedes them.

All theſe four are very pleaſant cooling ſyrups; and with this intention are occaſionally made uſe of in draughts and juleps, for quenching thirſt, abating heat, &c. in bilious or inflammatory diſtempers. They are ſometimes likewiſe employed in gargariſms for inflammations of the mouth and tonſils.

SYRUPUS PAPAVERIS ALBI.

Lond.

Syrup of the White Poppy.

Take of
- The heads of white poppies, dried, and the ſeeds taken out, three pounds and an half;

Double-refined fugar, fix pounds;
Diftilled water, eight gallons.

Slice and bruife the heads, then boil them in the water to three gallons, in a water-bath faturated with fea-falt, and prefs out the liquor. Reduce this by boiling to about the meafure of four pints, and ftrain it whilft it is hot, firft through a fieve, then through a thin woollen cloth, and fet it afide for twelve hours, that the feces may fubfide. Boil the liquor, poured off from the feces, to three pints, and diffolve the fugar in it that it may be made a fyrup.

SYRUPUS PAPAVERIS ALBI, *feu de* MECONIO, *vulgo* DIACODION.

Edin.

Syrup of White Poppies, or of Meconium, commonly called *Diacodium.*

Take of
White poppy heads, dried, and freed from the feeds, two pounds;
Boiling water, thirty pounds;
Pureft fugar, four pounds.

Macerate the bruifed heads in the water for a night; next boil till only one third part of the liquor remain; then ftrain it; expreffing it ftrongly. Boil the ftrained liquor to the confumption of one half, and ftrain again; laftly, add the fugar, and boil to a fyrup.

It may alfo be made by diffolving in two pounds and a half of fimple fyrup, one dram of the extract of white poppies.

This fyrup, impregnated with the opiate matter of the poppy heads, is given to children in dofes of two or three drams; to adults, from half an ounce to an ounce and upwards, for eafing pain and procuring reft.

SYRUPUS PAPAVERIS ERRATICI.

Lond.

Syrup of the Red Poppy.

Take of
The frefh flowers of the wild, or red, poppy, four pounds;
Boiling diftilled water, four pints and an half.

Put the flowers, by degrees, into the boiling water, in a water-bath, conftantly ftirring them. After this, the veffel being taken out of the bath, macerate for twelve hours; then prefs out the liquor, and fet it apart, that the feces may fubfide. Laftly, make it into a fyrup, with double-refined fugar.

This fyrup has been recommended in diforders of the breaft, coughs, fpitting of blood, pleurifies, and other difeafes, both as an emollient and as an opiate.

SYRUPUS ROSÆ.

Lond.

Rose-Syrup.

Take of
The dried petals of the damask rose, seven ounces;
Double-refined sugar, six pounds;
Boiling distilled water, four pints.

Macerate the petals of the rose in water for twelve hours, and strain. Evaporate the strained liquor to two pints and an half, and add the sugar, that it may be made a syrup.

SYRUPUS ROSARUM PALLIDARUM.

Edin.

Syrup of Pale Roses.

Take of
Pale roses, fresh gathered, one pound;
Boiling water, four pounds;
White sugar, three pounds.

Macerate the roses in the water for a night; then to the liquor strained, and freed from the dregs, add the sugar; boil them into a syrup.

This syrup may likewise be made from the liquor remaining after the distillation of rose-water, depurated from its feces.

This syrup is an agreeable and mild purgative for children, in the dose of half a spoonful, or a spoonful. It likewise proves gently laxative to adults; and with this intention may be of service in costive habits.

SYRUPUS e ROSIS SICCIS.

Edin.

Syrup of Dry Roses.

Take of
Red roses, dried, seven ounces;
White sugar, six pounds;
Boiling water, five pounds.

Infuse the roses in the water for a night, then boil them a little; strain out the liquor, and adding to it the sugar, boil them to the consistence of a syrup.

This syrup is supposed to be mildly astringent: but is principally valued on account of its red colour.

SYRUPUS SCILLITICUS.

Edin.

Syrup of Squills.

Take of
Vinegar of squills, two pounds;

White fugar, three pounds and a half.
Make them into a fyrup with a gentle heat.

This fyrup is ufed chiefly in dofes of a fpoonful or two, for promoting expectoration, which it does very powerfully.

SYRUPUS SIMPLEX, *five* COMMUNIS.

Edin.

Simple or Common Syrup.

Take of
Pureft fugar, fifteen parts;
Water, eight parts.
Let the fugar be diffolved by a gentle heat.

This preparation is a plain liquid fweet, void of flavour or colour.

SYRUPUS SPINÆ CERVINÆ.

Lond.

Syrup of Buckthorn.

Take of
The juice of ripe and frefh buckthorn berries, one gallon;
Ginger, bruifed, one ounce;
All-fpice, powdered, one ounce and an half;
Double-refined fugar, feven pounds.
Set by the juice for fome days, that the feces may fubfide, and ftrain. Macerate the ginger and all-fpice in a pint of the ftrained juice, for four hours, and ftrain. Boil away the reft of the juice to three pints; then add that part of the juice in which the ginger and all-fpice have been macerated; and, laftly, the fugar, that it may be made a fyrup.

SYRUPUS *e* RHAMNO CATHARTICO *feu e* SPINA CERVINA.

Edinb.

Syrup of Buckthorn.

Take of
The juice of ripe buckthorn berries, depurated, feven pounds and a half;
White fugar, three pounds and a half.
Boil them to the confiftence of a fyrup.

Both thefe preparations, in dofes of three or four fpoonfuls, operate as brifk cathartics.

SYRUPUS TOLUTANUS.

Lond.

Syrup of Balsam of Tolu.

Take of

The balsam of Tolu, eight ounces;

Distilled water, three pints.

Boil for two hours. Mix with the liquor, strained after it is cold, the double refined sugar, that it may be made a syrup.

SYRUPUS BALSAMICUS.

Edinb.

Balsamic Syrup.

Take of

The syrup of sugar, just made, and warm from the fire, two pounds;

Tincture of the balsam of Tolu, one ounce.

When the syrup has grown almost cold, stir into it the tincture, by little at a time, agitating them well together, till perfectly united.

These syrups are both moderately impregnated with the agreeable flavour of the balsam.

SYRUPUS VIOLÆ.

Lond.

Syrup of Violets.

Take of

The fresh petals of the violet, two pounds;

Boiling distilled water, five pints.

Macerate for twenty-four hours; afterwards strain the liquor, without pressing, through thin linen. Add refined sugar, that it may be made a syrup.

SYRUPUS VIOLARUM.

Edinb.

Syrup of Violets.

Take of

Fresh violets, one pound;

Boiling water, four pounds;

Purest sugar, seven pounds and a half.

Macerate the violets in the water for twenty-four hours in a glass, or at least a glazed earthen vessel, close covered; then strain without expression, and to the strained liquor add the sugar, beat and make into a syrup.

This syrup is of a very agreeable flavour; and in the quantity of a spoonful or two proves to children gently laxative.

SYRUPUS ZINZIBERIS.

Lond.

Syrup of Ginger.

Take of
Ginger bruised, four ounces;
Boiling distilled water, three pints.
Macerate for four hours, and strain; then add the refined sugar, that it may be made a syrup.

Edinb.

Take of
Beat ginger, three ounces;
Boiling water, four pounds;
Purest sugar, seven pounds and a half.
Macerate the ginger in the water in a close vessel for twenty-four hours; then to the liquor strained, and freed from the feces, add the beat sugar, and make them into a syrup.

These are agreeable and moderately aromatic syrups, lightly impregnated with the flavour and virtues of the ginger.

SYRUPUS ACIDUS.

Gen.

Acid Syrup.

Take of
Weak spirit of vitriol, two drams;
Syrup of lemon, six ounces.
Mix them.

Where we wish to obtain a syrup, not only strongly acidulated, but also powerfully astringent, this formula may be considered as well suited to answer the purpose.

SYRUPUS ALKALINUS.

Gen.

Alkaline Syrup.

Take of
Salt of tartar, three drams.
Simple syrup, six ounces.
Mix them.

This syrup may be usefully employed either for the destruction of acid in the stomach, or for the formation of neutral or effervescent mixtures.

SYRUPUS ALLII.

Suec.

Syrup of Garlic.

Take of
The fresh root of garlic, sliced, one pound;
Boiling water, two pounds.
Macerate them in a close vessel for an hour; add to the strained liquor,
Refined sugar, two pounds.
Boil them to a syrup.

This syrup is recommended for promoting expectoration in cases of chronic catarrh, and other affections of the breast.

SYRUPUS AMYGDALINUS.

Suec.

Syrup of Almonds.

Take of
Sweet almonds, one pound;
Bitter almonds, two drams.
Let the almonds be blanched and beat in a stone mortar with a wooden pestle; then by degrees add barley-water, two pounds; strain the liquor, and form it into a syrup, with as much double-refined sugar as may be necessary.

The agreeable flavour of the almonds, is in this formula communicated to a syrup, which may be advantageously employed to sweeten mixtures, or to form a pleasant drink when diffused in water.

SYRUPUS CINNAMONI.

Ross.

Syrup of Cinnamon.

Take of
Cinnamon, bruised, five ounces;
Spirituous cinnamon-water, two pounds.
Digest them in a close glass vessel for twenty-four hours; then add to the strained liquor double-refined sugar, three pounds; boil it to a syrup.

This syrup is strongly impregnated with the cinnamon; and it is proper where we wish to sweeten any mixture, at the same time adding to it an agreeable aromatic.

SYRUPUS EMETICUS.

Brun.

Emetic Syrup.

Take of
Glass of antimony, finely powdered, two drams;

Rhenish wine, twelve ounces.

Let them be digested for three days in a gentle heat, then strain the liquor through paper, and mix with the strained liquor thirty ounces of double-refined sugar. Let it be formed into a syrup, and kept in a close vessel.

There can be no doubt of this syrup being strongly impregnated with the emetic quality of the antimony.

SYRUPUS HYDRARGYRI.

Suec.

Syrup of Quicksilver.

Take of

Purified quicksilver, one dram;

Gum arabic, three drams;

Rose-water, as much as is sufficient for reducing the gum to a mucus.

Let them be rubbed in a mortar till the quicksilver totally disappears; then by degrees mix it with simple syrup four ounces.

In this we have a preparation similar to the mercurial solution of Dr. Plenck, formerly mentioned.

Medicated Honeys.

Honeys differ little from the syrups: they are made by mixing the vegetable decoction or infusion in honey, and boiling them till the honey is reduced to its original consistence. Honey, however, being a particular substance, and liable often to produce morbid effects on the stomach and bowels, and also to pass readily into fermentation, this form is not so useful as the former.

MEL ROSÆ.

Lond.

Honey of Roses.

Take of

Red rose-buds, with the heels cut off and dried, four ounces;

Distilled water, boiling, three pints;

Clarified honey, five pounds.

Macerate the rose-petals in the water for six hours; then mix the honey with the strained liquor, and boil the mixture to the thickness of a syrup.

This preparation is not unfrequently made use of as a mild, cooling detergent, particularly in gargarisms, for ulcerations of the mouth and tonsils.

MEL SCILLÆ.
Lond.
Honey of Squills.

Take of
Clarified honey, three pounds;
Tincture of squills, two pints.
Boil them in a glass vessel to the thickness of a syrup.

The honey will here be impregnated with all the active parts of the squills.

OXYMEL ÆRUGINIS.
Lond.
Oxymel of Verdigris.

Take of
Prepared verdigris, one ounce;
Vinegar, seven ounces;
Clarified honey, fourteen ounces.
Dissolve the verdigris in the vinegar, and strain it through linen; then add the honey, and boil the whole to a proper thickness.

This is used only externally for cleansing foul ulcers, and keeping down fungous flesh.

OXYMEL COLCHICI.
Lond.
Oxymel of Meadow Saffron.

Take of
The fresh root of meadow saffron, cut into thin slices, one ounce;
Distilled vinegar, one pint;
Clarified honey, two pounds.
Macerate the root of meadow-saffron with the vinegar, in a glass vessel, with a gentle heat, for forty-eight hours. Strain the liquor, pressed out strongly from the root, and add the honey. Lastly, boil the mixture, frequently stirring it with a wooden spoon, to the thickness of a syrup.

This oxymel may be considered as very analogous to the syrupus colchici.

OXYMEL SCILLÆ.
Lond.
Oxymel of Squill.

Take of
Clarified honey, three pounds;
Vinegar of squill, two pints.
Boil them in a glass vessel, with a slow fire, to the thickness of a syrup.

Oxymel of squills is an useful aperient, detergent, and expectorant, and of great service in humoral asthmas, coughs, and other disorders where thick phlegm abounds. It is given in doses of two or three drams, along with some aromatic water.

OXYMEL SIMPLEX.
Lond.
Simple Oxymel.

Take of
Clarified honey, two pounds;
Distilled vinegar, one pint.
Boil them in a glass-vessel, with a slow fire, to the thickness of a syrup.

This is an agreeable, mild, cooling medicine. It is often used in cooling, detergent gargarisms, and not unfrequently as an expectorant.

OXYMEL *ex* ALLIO.
Dan.
Oxymel of Garlic.

Take of
Garlic, cut in slices, an ounce and a half;
Caraway seeds,
Sweet fennel seeds, each two drams;
Clarified honey, ten ounces;
Vinegar, half a pint.
Boil the vinegar for a little time with the seeds bruised, in a glazed earthen vessel; then add the garlic, and cover the vessel close; when grown cold, press out the liquor, and dissolve in it the honey by the heat of a water-bath.

This oxymel is recommended for attenuating viscid juices, promoting expectoration, and the fluid secretions in general.

OXYMEL PECTORALE.
Brun.
Pectoral Oxymel.

Take of
Elecampane roots, one ounce;
Florence orris roots, half an ounce;
Gum ammoniacum, one ounce;
Vinegar, half a pint;
Clarified honey, one pound;
Water, three pints.

Let the roots, cut and bruiſed, be boiled in the water till one-third is waſted; then ſtrain off the liquor; let it ſtand to ſettle; and having poured it off clear from the fæces, add to it the honey and the ammoniacum, previouſly diſſolved in the vinegar. Mix them together, by boiling them a little.

This compoſition is deſigned for thoſe diſorders of the breaſt that proceed from a load of viſcid phlegm and obſtruction of the pulmonary veſſels. Two or three ſpoonfuls may be taken every night and morning, and continued for ſome time.

Medicated Wines.

Wines are employed as a more agreeable menſtruum than ſpirits, for extracting the medical virtues of various ſubſtances; and though objections ariſe, from their being rather leſs active, yet in ſome caſes, from their proportion of acid they form powerful ſolvents, where metallic ſubſtances are diſſolved in them. When the preparation with wine is finiſhed and ſtrained, an addition of $\frac{1}{20}$ part of proof ſpirit ſhould be added, to prevent fermentation, and the air excluded from the veſſel.

VINUM ALOES.
Lond.
Wine of Aloes.

Take of
Socotorine aloes, eight ounces;
White canella, commonly called Winter's bark, two ounces;
Spaniſh white-wine, ſix pints;
Proof-ſpirit of wine, two pints.

Powder the aloes and white canella ſeparately; when mixed, pour on them the wine: afterwards digeſt for fourteen days, now and then ſhaking them; laſtly, ſtrain.

It will not be amiſs to mix white ſand, cleanſed from impurities, with the powder, in order to prevent the moiſtened aloes from getting into lumps.

VINUM ALOETICUM, *vulgo* TINCTURA SACRA.
Edinb.
Aloetic Wine, commonly called *Sacred Tincture.*

Take of
Socotorine aloes, one ounce;
Leſſer cardamom ſeeds,

Ginger, each one dram;
Spanish white wine, two pounds.
Digest for seven days, stirring now and then, and afterwards strain.

The *tinctura sacra* appears from long experience to be a medicine of excellent service. The dose, as a purgative, is from one to two ounces.

VINUM AMARUM, *sive* GENTIANÆ COMPOSITUM.
Edinb.
Bitter Wine, or Compound Gentian Wine.

Take of
Gentian root, half an ounce;
Peruvian bark, one ounce;
Seville orange-peel, dried, two drams;
Canella alba, one dram;
Proof spirit, four ounces;
Spanish white wine, two pounds and a half.
First pour on the spirit, and after twenty-four hours add the wine; then macerate for three days, and strain.

This wine is intended to supply the place of the *tinctura ad stomachicos*, as it was formerly called.

VINUM ANTIMONII.
Lond.
Wine of Antimony.

Take of
Vitrified antimony, powdered, one ounce;
Spanish white wine, a pint and an half.
Digest for twelve days, frequently shaking the vessel, and filter the wine through paper.

The antimonial wine possesses the whole virtues of that mineral, and may be so dosed and managed as to perform all that can be effected by any antimonial preparation. From ten to fifty or sixty drops, generally act as an alterative and diaphoretic; larger doses act as a diuretic and cathartic, while three or four drams prove for the most part violently emetic.

VINUM ANTIMONII TARTARISATI.
Lond.
Wine of Tartarised Antimony.

Take of
Tartarised antimony, two scruples;

Boiling diftilled water, two ounces;
Spanifh white wine, eight ounces.
Diffolve the tartarifed antimony in the boiling diftilled water, and add the wine.

VINUM ANTIMONII TARTARISATI, *vulgo* VINUM ANTIMONIALE.

Edinb.

Wine of Tartarifed Antimony, commonly called *Antimonial Wine.*

Take of
Tartarifed antimony, twenty-four grains;
Spanifh white wine, one pound.
Mix them fo as that the antimony may be diffolved.

Each ounce of this wine contains two grains of the tartarifed antimony.

VINUM FERRI.

Lond.

Wine of Iron.

Take of
Iron filings, four ounces;
Spanifh white wine, four pints.
Digeft for a month, often fhaking the veffel, and then ftrain.

Steel wine, as it was formerly called, is a very ufeful preparation of this metal, and frequently exhibited in chlorotic and other indifpofitions where chalybeates are proper. The dofe is from a dram to half an ounce; which may be repeated twice or thrice a day.

VINUM IPECACUANHÆ.

Lond.

Wine of Ipecacuanha.

Take of
The root of ipecacuanha, bruifed, two ounces;
Spanifh white wine, two pints.
Digeft for ten days, and ftrain.

VINUM, *vulgo* TINCTURA IPECACUANHÆ.

Edinb.

Wine, commonly called *Tincture of Ipecacuanha.*

Take of
Ipecacuanha, in powder, one ounce;
Spanifh white wine, fifteen ounces.
After three days ma

Both these wines are very mild and safe emetics, and equally serviceable in dysenteries, with the ipecacuanha in substance. The common dose is an ounce, more or less, according to the age and strength of the patient.

VINUM RHABARBARI.

Lond.

Wine of Rhubarb.

Take of
- Sliced rhubarb, two ounces and an half;
- Lesser cardamom-seeds, bruised and husked, half an ounce;
- Saffron, two drams;
- Spanish white wine, two pints;
- Proof spirit, half a pint.

Digest for ten days, and strain.

VINUM RHEI.

Edinb.

Rhubarb Wine.

Take of
- Rhubarb, two ounces;
- Canella alba, one dram;
- Proof spirit, two ounces;
- Spanish white wine, fifteen ounces.

Macerate for seven days, and strain.

This is a warm, cordial, laxative medicine. It is used chiefly in weakness of the stomach and bowels, and some kinds of loosenesses, for evacuating the offending matter, and strengthening the tone of the viscera. It may be given in doses of from half a spoonful to three or four spoonfuls or more, according to the circumstances of the disorder.

VINUM NICOTIANÆ.

Edinb.

Tobacco Wine.

Take of
- The dried leaves of the best Virginian tobacco, one ounce;
- Spanish white wine, one pound.

Macerate for four days, and then strain the liquor.

This wine is a very useful remedy in the cure of dropsies and dysuries.

VINUM SCILLITICUM.

Squill Wine.

Take of
Dried squill, sliced, one ounce;
Ginger, one dram;
French white wine, two pounds.
Macerate for three days, and then strain.

By the wine employed as a menstruum, the active properties of the squills may be readily extracted: and in some cases at least the present formula may justly be considered as entitled to a preference over either the acetum, or oxymel scillæ.

Tinctures.

Rectified spirit is the most complete solvent of vegetable matter, in the form of oil, resins, or sugar; and of the parts of animals which possess a peculiar taste and smell. Its solution consists of their active parts in their pure state, which renders it preferable to water; and their colours are communicated to it in the most complete manner. These colours may be heightened by the addition of fixed alkali, though it is apt to injure the quality of the medicine. The solvent power of spirit is increased by volatile alkali, but by acids, unless when changed to the dulcified form.

TINCTURA ALOES.

Lond. Edin.

Tincture of Aloes.

Take of
Socotorine aloes, powdered, half an ounce;
Extract of liquorice, an ounce and an half;
Distilled water,
Proof spirit, of each eight ounces
Digest in a sand-bath, now and then shaking the vessel, until the extract be dissolved; and then strain.

In cases where we wish for the operation of the aloes alone, this is perhaps one of the best formulæ under

TINCTURA ALOES COMPOSITA.

Lond.

Compound Tincture of Aloes.

Take of
 Socotorine aloes,
 Saffron, of each three ounces;
 Tincture of myrrh, two pints.
Digeſt for eight days; and ſtrain.

TINCTURA ALOES CUM MYRRHA, *vulgo* ELIXIR PROPRIETATIS.

Edinb.

Tincture of Aloes with Myrrh, commonly called *Elixir Proprietatis.*

Take of
 Myrrh in powder, two ounces;
 Socotorine aloes, an ounce and a half;
 Engliſh ſaffron, one ounce;
 Rectified ſpirit of wine,
 Proof-ſpirit, of each one pound.
Digeſt the myrrh with the ſpirits for the ſpace of four days; then add the aloes in powder, and the ſaffron; continue the digeſtion for two days longer, ſuffer the feces to ſubſide, and pour off the clear elixir.

This medicine is highly recommended, and not undeſervedly, as a warm ſtimulant and aperient. It ſtrengthens the ſtomach, evacuates the inteſtinal canal, and promotes the natural ſecretions in general. Its continued uſe has frequently done much ſervice in cachectic and icteric caſes, uterine obſtructions, and other ſimilar diſorders; particularly in cold, pale, phlegmatic habits. The doſe may be from twenty drops to a tea-ſpoonful or more, twice or thrice a day.

TINCTURA ALOES VITRIOLATA, *vulgo* ELIXIR PROPRIETATIS VITRIOLATUM.

Edinb.

Vitriolated Tincture of Aloes, commonly called *Elixir Vitriolic Proprietatis.*

Take of
 Myrrh,
 Socotorine aloes, of each an ounce and an half;
 Engliſh ſaffron, one ounce.

Digest the myrrh with the spirit for four days in a close vessel; then add the saffron and aloes
Digest again four days; and when the feces have subsided, pour off the tincture.

This tincture possesses the general properties of the preceding.

TINCTURA AROMATICA, *sive* CINNAMOMI COMPOSITA.

Edinb.

Aromatic Tincture, or Compound Tincture of Cinnamon.

Take of
 Cinnamon, six drams;
 Lesser cardamom seeds, one ounce;
 Garden angelica-root, three drams;
 Long pepper, two drams;
 Proof-spirit, two pounds and an half.
Macerate for seven days, and filter the tincture.

This very warm aromatic is too hot to be given without dilution. A tea-spoonful or two may be taken in wine, or any other convenient vehicle, in languors, weakness of the stomach, flatulencies, and other similar complaints.

TINCTURA ASAFOETIDA.

Lond.

Tincture of Asafœtida.

Take of
 Asafœtida, four ounces;
 Rectified spirit of wine, two pints.
Digest with a gentle heat for six days; and strain.

TINCTURA ASAFOETIDA, *vulgo* TINCTURA FOETIDA.

Edinb.

Tincture of Asafœtida, commonly called Fœtid Tincture.

Take of
 Asafœtida, four ounces;
 Rectified spirit of wine, two pounds and an half.
Digest for six days; and strain.

This tincture possesses the virtues of the asafœtida itself; and may be given in doses of from ten drops to fifty or sixty.

TINCTURA AURANTII CORTICIS.

Lond.

Tincture of Orange-Peel.

Take of

Fresh orange-peel, three ounces;

Proof spirit, two pounds.

Digest for three days; and strain.

This tincture is an agreeable bitter, flavoured at the same time with the essential of the orange-peel.

TINCTURA BALSAMI PERUVIANI.

Lond.

Tincture of the Balsam of Peru.

Take of

Balsam of Peru, four ounces;

Rectified spirit of wine, one pint.

Digest until the balsam be dissolved.

This tincture is at present but little employed, unless in composition, either under this or any other form.

TINCTURA BALSAMI TOLUTANI.

Lond.

Tincture of Balsam of Tolu.

Take of

Balsam of Tolu, one ounce and an half;

Rectified spirit of wine, one pint.

Digest until the balsam be dissolved, and strain.

TINCTURA TOLUTANA.

Edinb.

Tincture of Tolu.

Take of

Balsam of Tolu, an ounce and half;

Rectified spirit of wine, one pound.

Digest until the balsam be dissolved; and then strain the tincture.

This solution of balsam of Tolu possesses all the virtues of the balsam itself. It may be taken internally, with the several intentions for which that balsam is proper, to the quantity of a tea-spoonful or two, in any convenient vehicle. Mixed with the plain syrup of sugar, it forms an elegant balsamic syrup.

TINCTURA BENZOES COMPOSITA.

Lond.

Compound Tincture of Benzoin.

Take of
Benzoin, three ounces;
Storax, ſtrained, two ounces;
Balſam of Tolu, one ounce;
Socotrine aloes, half an ounce;
Rectified ſpirit of wine, two pints.
Digeſt with a gentle heat for three days, and ſtrain.

TINCTURA BENZOINI COMPOSITA, *vulgo* BALSAMUM TRAUMATICUM.

Edinb.

Compound Tincture of Benzoin, commonly called *Traumatic Balſam.*

Take of
Benzoin, three ounces;
Balſam of Peru, two ounces;
Hepatic aloes, half an ounce;
Rectified ſpirit of wine, two pounds.
Digeſt them in ſand-heat for the ſpace of ten days, and then ſtrain the balſam.

The compound tincture of benzoin or traumatic balſam, ſtands highly recommended, externally, for cleanſing and healing wounds and ulcers, for diſcuſſing cold tumours, allaying gouty, rheumatic, and other old pains and aches; and likewiſe internally, for warming and ſtrengthening the ſtomach and inteſtines, expelling flatulencies, and relieving colicy complaints. Outwardly, it is applied cold on the part with a feather; inwardly a few drops are taken at a time, in wine, or any other convenient vehicle.

TINCTURA CANTHARIDIS.

Lond.

Tincture of the Spaniſh Fly.

Take of
Bruiſed cantharides, two drams;
Cochineal, powdered, half a dram;
Proof-ſpirit, one pint and an half.
Digeſt for eight days, and ſtrain.

Edinb.

Take of
Cantharides, one dram;

Proof-spirit, one pound.
Digest for four days, and strain through paper.

The usual dose of these tinctures is from ten to twenty drops, which may be taken in a glass of water, or any other more agreeable liquor, twice a day; and increased by two or three drops at a time, according to the effect. The tincture of cantharides has of late been highly celebrated as a successful remedy in diabetic cases.

TINCTURA CARDAMOMI.

Lond.

Tincture of Cardamom.

Take of
Lesser cardamom-seeds, husked and bruised, three ounces;
Proof-spirit, two pints.
Digest for eight days, and strain.

Edinb.

Take of
Lesser cardamom seeds, four ounces;
Proof-spirit, two pounds and an half.
Macerate for eight days, and strain through paper.

Tincture of cardamoms has been in use for a considerable time. It is a pleasant, warm cordial; and may be taken, along with any proper vehicle, in doses of from a dram to a spoonful or two.

TINCTURA CARDAMOMI COMPOSITA.

Lond.

Compound Tincture of Cardamom.

Take of
Lesser cardamom-seeds, husked,
Caraway-seeds,
Cochineal, each, powdered, two drams;
Cinnamon bruised, half an ounce;
Raisins, stoned, four ounces;
Proof spirit, two pints
Digest for fourteen days, and strain.

This tincture contains so small a proportion of cardamoms as to be hardly entitled to derive its name from that article.

TINCTURA CASCARILLÆ.

Lond.

Tincture of Cascarilla.

Take of
The bark of cascarilla, powdered, four ounces;
Proof-spirit, two pints.
Digest with a gentle heat for eight days, and strain.

This tincture may be employed to answer most of those purposes for which the bark itself is recommended.

TINCTURA CASTOREI.

Lond.

Tincture of Castor.

Take of
Russia castor, powdered, two ounces;
Proof-spirit, two pints.
Digest for ten days, and strain.

Edinb.

Take of
Russia castor, an ounce and a half;
Rectified spirit of wine, one pound.
Digest them for six days, and afterwards strain off the liquor.

The tincture of castor is recommended in most kinds of nervous complaints and hysteric disorders: the dose is from twenty drops to forty, fifty, or more.

TINCTURA CASTOREI COMPOSITA.

Edinb.

Compound Tincture of Castor.

Take of
Russian castor, one ounce;
Asafœtida, half an ounce;
Spirit of ammonia, one pound.
Digest for six days in a close-stopped phial, and strain.

This composition is a medicine of real efficacy, particularly in hysterical disorders, and the several symptoms which accompany them.

TINCTURA CATECHU.

Lond.

Tincture of Catechu.

Take of
Catechu, three ounces;

Cinnamon, bruifed, two ounces;
Proof-fpirit, two pints.
Digeft for three days, and ftrain.

TINCTURA CATECHU, *vulgo* TINCTURA JAPONICA.

Edinb.

Tincture of Catechu, commonly called *Japonic Tincture.*

Take of
Infpiffated juice of catechu, three ounces;
Proof-fpirit, two pounds and a half.
Digeft for eight days, and ftrain.

This tincture is of fervice in all kinds of defluxions, catarrhs, loofeneffes, uterine fluxes, and other diforders, where mild aftringent medicines are indicated. Two or three tea-fpoonfuls may be taken every now and then.

TINCTURA CINNAMOMI.

Lond.

Tincture of Cinnamon.

Take of
Cinnamon, bruifed, one ounce and an half;
Proof-fpirit, one pint.
Digeft for ten days, and ftrain.

Edinb.

Take of
Cinnamon, three ounces;
Proof-fpirit, two pounds and a half.
Macerate for eight days, and ftrain.

The tincture of cinnamon poffeffes the reftringent virtues of the cinnamon, as well as its aromatic cordial ones.

TINCTURA CINNAMOMI COMPOSITA.

Lond.

Compound Tincture of Cinnamon

Take of
Cinnamon, bruifed, fix drams;
Leffer cardamom-feeds, hufked, three drams;
Long pepper,
Ginger, of each, in powder, two drams;
Proof-fpirit, two pints.
Digeft for eight days, and ftrain.

From the different articles which this tincture contains, it must necessarily be of a more hot and fiery nature than the former.

TINCTURA COLUMBÆ.

Lond.

Tincture of Columba.

Take of
Colomba root, powdered, two ounces and an half;
Proof-spirit, two pints.
Digest for eight days, and strain.

Edinb.

Take of
Colomba root, powdered, two ounces;
Proof-spirit, two pounds.
Digest for eight days, and strain.

This tincture may be advantageously employed against bilious vomitings, and those different stomachic ailments, in which the columba has been found useful.

TINCTURA CINCHONÆ, *sive* CORTICIS PERUVIANI.

Lond.

Tincture of Peruvian Bark.

Take of
Peruvian bark, powdered, six ounces;
Proof-spirit, two pints.
Digest with a gentle heat for eight days, and strain.

TINCTURA CORTICIS PERUVIANI.

Edinb.

Tincture of Peruvian Bark.

Take of
Peruvian bark, four ounces;
Proof-spirit, two pounds and a half.
Digest for ten days, and strain.

This tincture may be given in doses of from a tea-spoonful to half an ounce, or an ounce, according to the different purposes it is intended to answer.

TINCTURA CINCHONÆ, *sive* CORTICIS PERUVIANI COMPOSITA.

Lond.

Compound Tincture of Peruvian Bark.

Take of
Peruvian bark, powdered, two ounces;

Exterior peel of Seville oranges, dried, one ounce and an half;
Virginian ſnake-root, bruiſed, three drams;
Saffron, one dram;
Cochineal, powdered, two ſcruples;
Proof-ſpirit, twenty ounces.

Digeſt for fourteen days, and ſtrain.

As a corroboant and ſtomachic it is given in doſes of two or three drams: but when employed for the cure of intermittents, it muſt be taken to a greater extent.

TINCTURA CINCHONÆ, *ſive* CORTICIS PERUVIANI AMMONIATA.

Lond.

Ammoniated Tincture of Peruvian Bark.

Take of
Peruvian bark, powdered, four ounces;
Compound ſpirit of ammonia, two pints.

Digeſt them in a cloſe veſſel for ten days, and ſtrain.

This compoſition ſeems unneceſſary.

TINCTURA CROCI.

Edinb.

Tincture of Saffron.

Take of
Engliſh ſaffron, one ounce;
Proof-ſpirit, fifteen ounces.

After digeſting them for five days, let the tincture be ſtrained through paper.

TINCTURA FERRI MURIATI.

Lond.

Tincture of Muriated Iron.

Take of
The ruſt of iron, half a pound;
Muriatic acid, three pounds;
Rectified ſpirit of wine, three pints.

Pour the muriatic acid on the ruſt of iron in a glaſs veſſel; and ſhake the mixture now and then during three days. Set it by that the feces may ſubſide; then pour off the liquor; evaporate this to one pint, and when cold, add to it the vinous ſpirit.

TINCTURA FERRI, *vulgo* TINCTURA MARTIS.

Edinb.

Tincture of Iron.

Take of
The ſcales of iron, purified and powdered, three ounces;

Muriatic acid, as much as is sufficient to dissolve the powder.
Digest with a gentle heat; and the powder being dissolved, add of rectified spirit of wine as much as will make up the whole liquor two pounds and a half.

From ten to twenty drops of either of the tinctures may be taken twice or thrice a day, in any proper vehicle.

TINCTURA FERRI AMMONIACALIS.
Lond.
Ammoniac Tincture of Iron.

Take of
Ammoniacal iron, four ounces;
Proof spirit, one pint.
Digest and strain.

This is the old *tinctura florum martialium.*

TINCTURA GALBANI.
Lond.
Tincture of Galbanum.

Take of
Galbanum, cut in small pieces, two ouuces;
Proof-spirit, two pints.
Digest with a gentle heat for eight days, and strain.

This tincture may be successfully employed in cases of flatulence and hysteria, where its effects are immediately required, particularly with those who cannot bear asafœtida.

TINCTURA GENTIANÆ COMPOSITA.
Lond.
Compound Tincture of Gentian.

Take of
Gentian root, sliced and bruised, two ounces;
Exterior dried peel of Seville oranges, one ounce;
Lesser cardamom seeds, husked and bruised, half an ounce;
Proof-spirit, two pints.
Digest for eight days, and strain.

TINCTURA AMARA, *sive* GENTIANÆ COMPOSITA, *vulgo* ELIXIR STOMACHICUM.
Edinb.
Bitter Tincture, or *Compound Tincture of Gentian,* commonly called *Stomachic Elixir.*

Take of
Gentian root, two ounces;

Seville orange-peel, dried, one ounce;
Canella alba, half an ounce;
Cochineal, half a dram;
Proof-ſpirit, two pounds and a half.
Macerate for four days, and ſtrain through paper.

These are very elegant ſpirituous bitters.

TINCTURA GUAIACI, *vulgo* ELIXIR GUAIACINUM.
Edinb.
Tincture of Guaiacum, commonly called *Elixir of Guaiacum*.

Take of
Gum guaiacum, one pound;
Rectified ſpirit of wine, two pounds and a half.
Digeſt for ten days, and ſtrain.

TINCTURA GUAIACI.
Lond.
Tincture of Guaiacum.

Take of
Gum guaiacum, four ounces;
Compound ſpirit of ammonia, a pint and a half.
Digeſt for three days, and ſtrain.

TINCTURA GUAIACI AMMONIATA, *vulgo* ELIXIR GUAIACINUM VOLATILE.
Edinb.
Ammoniated Tincture of Guaiacum, commonly called *Volatile Elixir of Guaiacum*.

Take of
Gum guaiacum, four ounces;
Diſtilled oil of ſaſſafras, half a dram;
Spirit of ammonia, a pound and a half.
Macerate for ſix days in a cloſe veſſel, and ſtrain.

Theſe are very elegant and efficacious tinctures; the volatile ſpirit excellently diſſolving the gum, and at the ſame time promoting its medicinal virtue. In rheumatic caſes, a tea, or even table, ſpoonful, taken every morning and evening in any convenient article, particularly in milk, has proved of ſingular ſervice.

TINCTURA HELLEBORI NIGRI.
Lond.
Tincture of Black Hellebore.

Take of
Black hellebore-root, in coarſe powder, four ounces;

Cochineal, powdered, two scruples;
Proof-spirit, two pints.
Digest with a gentle heat for eight days, and strain.

TINCTURA MELAMPODII, *five* HELLEBORI NIGRI.

Edinb.

Tincture of Melampodium, or Black Hellebore.

Take of
Black hellebore root, four ounces;
Cochineal, half a dram;
Proof-spirit, two pounds and a half.
Digest for eight days, and filter the tincture through paper.

This tincture has been found, from experience, particularly serviceable in uterine obstructions: in sanguine constitutions, where chalybeates are hurtful, it seldom fails of exciting the menstrual evacuations, and removing the ill consequences of their suppression. A tea-spoonful of the tincture may taken twice a day in warm water, or any other convenient vehicle.

TINCTURA JALAPII.

Lond.

Tincture of Jalap.

Take of
Powdered jalap root, eight ounces;
Proof-spirit, two pints.
Digest with a gentle heat for eight days, and strain.

TINCTURA JALAPÆ.

Edinb.

Tincture of Jalap.

Take of
Jalap, in coarse powder, three ounces;
Proof-spirit, fifteen ounces
Digest them for eight days, and strain the tincture.

TINCTURA KINO.

Edinb.

Tincture of Gum Kino.

Take of
Gum kino, two ounces;
Proof-spirit, a pound and an half.
Digest eight days, and strain.

This is one of the beſt forms under which it can be exhibited in obſtinate diarrhœas, and in caſes of lienteria.

SPIRITUS LAVENDULÆ COMPOSITA.

Lond

Compound Spirit of Lavender.

Take of
 Spirit of lavender, three pints;
 Spirit of roſemary, one pint;
 Cinnamon, bruiſed,
 Nutmegs, bruiſed, of each half an ounce;
 Red ſaunders, one ounce.
Digeſt for ten days, and ſtrain.

SPIRITUS LAVENDULÆ COMPOSITUS.

Lond.

Compound Spirit of Lavender.

Take of
 Simple ſpirit of lavender, three pounds;
 Simple ſpirit of roſemary, one pound;
 Cinnamon, one ounce;
 Cloves, two drams;
 Nutmeg, half an ounce;
 Red ſaunders, three drams.
Macerate ſeven days, and ſtrain.

Theſe ſpirits are grateful reviving cordials, and have been long holden in great eſteem, under the name of Palſy Drops, in all kinds of languors, weakneſs of the nerves, and decays of the aged.

TINCTURA MOSCHI.

Edinb.

Tincture of Muſk.

Take of
 Muſk, two drams;
 Rectified ſpirit of wine, one pound.
Digeſt for ten days, and ſtrain.

TINCTURA MYRRHÆ.

Lond.

Tincture of Myrrh.

Take of
 Myrrh, bruiſed, three ounces;
 Proof ſpirit a pint and an half;
 Rectified ſpirit of wine, half a pint.
Digeſt with a gentle heat for eight days, and ſtrain.

TINCTURA MYRRHÆ.
Edinb.
Tincture of Myrrh.

Take of
Myrrh, three ounces;
Proof-ſpirits, two pounds and a half.
After digeſtion for ten days, ſtrain off the tincture.

Tincture of myrrh is recommended internally for warming the habit, ſtrengthening the ſolids, opening obſtructions, and reſiſting putrefaction. The doſe is from fifteen drops to forty or more.

TINCTURA OPII.
Lond.
Tincture of Opium.

Take of
Hard purified opium, powdered, ten drams;
Proof-ſpirit, one pint.
Digeſt for ten days, and ſtrain.

TINCTURA OPII, *ſive* THEBAICA, *vulgo* LAUDANUM LIQUIDUM.
Edinb.
Tincture of Opium, or *Thebaic Tincture,* commonly called *Liquid Laudanum.*

Take of
Opium, two ounces;
Proof-ſpirit, two pounds.
Digeſt four days, and ſtrain off the tincture.

TINCTURA OPII CAMPHORATA.
Lond.
Camphorated Tincture of Opium.

Take of
Hard purified opium,
Flowers of benzoin, of each one dram;
Camphor, two ſcruples;
Oil of aniſeed, one dram;
Proof-ſpirit, two pints
Digeſt for ten days, and ſtrain.

TINCTURA OPII AMMONIATA, *vulgo* ELIXIR PAREGORICUM.
Edinb.
Ammoniated Tincture of Opium, commonly called *Paregoric Elixir.*

Take of
Acid of benzoin,

English saffron, of each three drams;
Opium, two drams;
Distilled oil of aniseeds, half a dram;
Spirit of ammonia, sixteen ounces.
Digest four days in a close vessel, and strain.

This tincture contributes to allay the tickling which provokes frequent coughing; and at the same time is supposed to open the breast, and give greater liberty of breathing: the opium procures a temporary relief from the symptoms, while the other ingredients tend to remove the cause, and prevent their return. It is given to children against the chincough, &c. in doses of from five drops to twenty; to adults from twenty to an hundred.

TINCTURA RHABARBARI.

Lond.

Tincture of Rhubarb.

Take of
Rhubarb, sliced, two ounces;
Lesser cardamom seeds, bruised, half an ounce;
Saffron, two drams;
Proof-spirit, two pints.
Digest for eight days, and strain.

TINCTURA RHEI.

Edinb.

Tincture of Rhubarb.

Take of
Rhubarb, three ounces;
Lesser cardamom seeds, half an ounce;
Proof-spirit, two pounds and a half.
Digest for seven days, and strain.

TINCTURA RHABARBARI COMPOSITA.

Lond.

Compound Tincture of Rhubarb.

Take of
Rhubarb, sliced, two ounces;
Ginger, powdered,
Saffron, each two drams;
Liquorice-root, bruised, half an ounce;
Distilled water, one pint;
Proof spirit, twelve ounces by measure.
Digest for fourteen days, and strain.

TINCTURA RHEI AMARA.
Edinb.
Bitter Tincture of Rhubarb.

Take of
Rhubarb, two ounces;
Gentian-root, half an ounce;
Virginian snake-root one dram;
Proof-spirit, two pounds and a half.
Digest for seven days, and strain.

TINCTURA RHEI DULCIS.
Edinb.
Sweet Tincture of Rhubarb.

It is made by adding to the strained tincture of rhubarb, four ounces of sugar-candy.

All the foregoing tinctures of rhubarb are designed as stomachics and corroborants, as well as purgatives. In weaknesses of the stomach, indigestion, laxity of the intestines, diarrhœas, colic, and other similar complaints, these medicines are frequently of great service.

TINCTURA RHEI CUM ALOE, *vulgo* ELIXIR SACRUM.
Edinb.
Tincture of Rhubarb with Aloes, commonly called *Sacred Elixir.*

Take of
Rhubarb, ten drams;
Socotorine aloes, six drams;
Lesser cardamom seeds, half an ounce;
Proof-spirit, two pounds and a half.
Digest for seven days, and strain.

This preparation is very much employed as a warming cordial purge.

TINCTURA SABINÆ COMPOSITA.
Lond.
Compound Tincture of Savin.

Take of
Extract of savin, one ounce;
Tincture of castor, one pint;
Tincture of myrrh, half a pint.
Digest till the extract of savin be dissolved, and then strain.

This preparation may be given in doses of from five drops to twenty or thirty, or more, in penny-royal water, or any other suitable vehicle.

TINCTURA SCILLÆ.
Lond.
Tincture of Squill.

Take of
Squills, fresh dried, four ounces;
Proof spirit, two pints.
Digest for eight days, and pour off the liquor.

TINCTURA SENNÆ.
Lond.
Tincture of Senna.

Take of
Senna, one pound;
Caraway-seeds, bruised, one ounce and an half;
Lesser cardamom-seeds, bruised, half an ounce;
Raisins, stoned, sixteen ounces;
Proof spirit, one gallon.
Digest for fourteen days, and strain.

TINCTURA SENNÆ COMPOSITA, *vulgo* ELIXIR SALUTIS.
Edinb.
Compound Tincture of Senna, commonly called *Elixir of Health.*

Take of
Senna leaves, two ounces;
Jalap root, one ounce;
Coriander seeds, half an ounce;
Proof spirit, three pounds and half.
Digest for seven days, and to the strained liquor add four ounces of sugar-candy.

Both these tinctures oftentimes relieve flatulent complaints and colics, where the common cordials have little effect: the dose is from one to two ounces.

TINCTURA SERPENTARIÆ.
Lond.
Tincture of Snake root.

Take of
Virginian snake root, three ounces;
Proof-spirit, two pints.
Digest for eight days, and strain.

Edinb.

Take of
Virginian snake root, two ounces;

Cochineal, one dram;
Proof-ſpirit, two pounds and a half.
Digeſt for four days, and then ſtrain the tincture.

This tincture may be taken to the quantity of a ſpoonful or more every five or ſix hours; and to this extent it often operates as a uſeful diaphoretic.

TINCTURA VALERIANÆ.
Lond.
Tincture of Valerian.

Take of
The root of wild valerian, in coarſe powder, four ounces;
Proof-ſpirit, two pints.
Digeſt with a gentle heat for eight days, and ſtrain.

This tincture proves of a deep colour, and conſiderably ſtrong of the valerian, though it has not been found to anſwer ſo well in the cure of epileptic diſorders as the root in ſubſtance, exhibited in the form of powder, or bolus. The doſe of this tincture is from half a ſpoonful to a ſpoonful or more, twice or thrice a day.

TINCTURA VALERIANÆ AMMONIATA.
Lond.
Ammoniated Tincture of Valerian.

Take of
The root of wild valerian, in coarſe powder, four ounces;
Compound ſpirit of ammonia, two pints.
Digeſt for eight days, and ſtrain.

TINCTURA VALERIANÆ AMMONIATA, *vulgo* TINCTURA VALERIANÆ VOLATILIS.
Edinb.
Ammoniated Tincture of Valerian, commonly called *Volatile Tincture of Valerian.*

Take of
Wild valerian root, two ounces;
Spirit of ammonia, one pound
Macerate for ſix days in a cloſe veſſel, and ſtrain.

The doſe may be a tea-ſpoonful or two.

TINCTURA VERATRI, *ſive* HELLEBORI ALBI.
Edinb.
Tincture of Veratrum, or White Hellebore.

Take of
White hellebore root, eight ounces;

Proof-ſpirit, two pounds and a half.
Digeſt them together for ten days, and filter through paper.

This tincture is ſometimes uſed for acuating cathartics, &c. and as an emetic in apoplectic and maniacal diſorders. It may likewiſe be ſo managed as to prove a powerful alterative and deobſtruent, in caſes where milder remedies have little effect; but a great deal of caution is requiſite in its uſe: the doſe, at firſt, ought to be only a few drops; if conſiderable, it proves violently emetic or cathartic.

ACIDUM VITRIOLI AROMATICUM, *vulgo* ELIXIR ELIXIR ACIDUM.

Edinb.

Aromatic Acid of Vitriol, commonly called *Acid Elixir of Vitriol.*

Take of
Rectified ſpirit of wine, two pounds;
Drop into it by little and little ſix ounces of vitriolic acid; digeſt the mixture with a very gentle heat in a cloſe veſſel for three days, and then add of
Cinnamon, an ounce and a half;
Ginger, one ounce.
Digeſt again in a cloſe veſſel for ſix days, and then filter the tincture through paper in a glaſs funnel.

This is a valuable medicine in weakneſs and relaxations of the ſtomach, and decays of conſtitution, particularly in thoſe which proceed from irregularities, which are accompanied with ſlow febrile ſymptoms, or which follow the ſuppreſſion of intermittents. It frequently ſucceeds after bitters and aromatics by themſelves had availed nothing.

SPIRITUS ÆTHERIS VITRIOLICI AROMATICUS, *vulgo* ELIXIR VITRIOLI DULCE.

Edinb.

Aromatic Spirit of Vitriolic Ether, commonly called *Sweet Elixir of Vitriol.*

This is made of the ſame aromatics, and in the ſame manner as the tinctura aromatica; except that, in the place of the vinous ſpirit, ſpirit of vitriolic ether is employed.

This is deſigned for perſons whoſe ſtomachs are too weak to bear the foregoing acid elixir; to the taſte it is gratefully aromatic, without any perceptible acidity.

TINCTURA ZINZIBERIS.
Lond.
Tincture of Ginger.

Take of
Ginger, powdered, two ounces;
Proof-spirit, two pounds.
Digest in a gentle heat for eight days, and strain.

This simple tincture of ginger is a warm cordial, and is rather intended as a useful addition, in the quantity of a dram or two, to purging mixtures.

TINCTURA COLOCYNTHIDIS.
Suec.
Tincture of Colocynth.

Take of
Colocynth, cut small, and freed from the seeds, one ounce;
Aniseed, one dram;
Proof-spirit, fourteen ounces.
Macerate for three days, and strain through paper.

In this tincture we have the active purgative power of the colocynth.

TINCTURA QUASSIÆ.
Suec.
Tincture of Quassia.

Take of
Quassia, bruised, two ounces;
Proof spirit, two pounds and an half.
Digest for three days, and then strain through paper.

Under this form it may be advantageously employed for answering different purposes in medicine.

TINCTURA LACCÆ.
Suec.
Tincture of Lac.

Take of
Gum lac, powdered, one ounce;
Myrrh, three drams;
Spirit of scurvy-grass, a pint and an half.
Digest in a sand-heat for three days; after which, strain off the tincture for use.

This tincture is principally employed for strengthening the gums, and in bleedings and scorbutic exulcerations of

TINCTURA NUCIS VOMICÆ.

R. Ss.

Tincture of Nux Vomica.

Take of
Nux vomica, an ounce and an half;
Proof-spirit, two pounds.
Digest for some days, and then strain it.

The nux vomica, a very active vegetable, has of late been introduced into practice for the cure of intermittents and of contagious dysentery.

TINCTURA SUCCINI.

Succ.

Tincture of Amber.

Take of
Yellow amber, powdered, one ounce;
Vitriolic æther, four ounces
Digest for three days in a vessel, accurately closed, frequently shaking the vessel, and after this strain through paper.

This tincture has been recommended in a variety of affections, particularly those of the nervous kind, as hysterical and epileptic complaints. It may be taken in doses of from a few drops to the extent of a tea-spoonful in a glass of wine or any similar vehicle.

Mixtures.

MISTURA CAMPHORATA.

Lond.

Camphorated Mixture.

Take of
Camphor, one dram;
Rectified spirit of wine, a little;
Double refined sugar, half an ounce;
Boiling distilled water, one pint.
Rub the camphor first with the spirit of wine, then with the sugar; lastly, add the water by degrees, and strain the mixture.

Camphor, under the present form as well as that of emulsion, is very useful in fevers, taken to the extent of a table-spoonful every three or four hours.

MISTURA CRETACEA.
Lond.
Chalk Mixture.

Take of
 Prepared chalk, one ounce;
 Double-refined fugar, fix drams;
 Gum Arabic, powdered, one ounce;
 Diftilled water, two pints.
Mix them.

POTIO CRETACEA.
Edinb.
Chalk Potion.

Take of
 Prepared chalk, one ounce;
 Pureft refined fugar, half an ounce;
 Mucilage of gum arabic, two ounces;
Rub them together, and add by degrees,
 Water, two pounds and an half;
 Spirit of cinnamon, two ounces.

This is a very elegant form of exhibiting chalk, and is an ufeful remedy in difeafes arifing from, or accompanied with, acidity in the primæ viæ. It is frequently employed in diarrhœa proceeding from that caufe. The dofe of this medicine requires no nicety. It may be taken to the extent of a pound or two in the courfe of a day.

MISTURA MOSCHATA.
Lond.
Mufk Mixture.

Take of
 Mufk, two fcruples;
 Gum arabic, powdered,
 Double-refined fugar, of each one dram;
 Rofe-water, fix ounces by meafure.
Rub the mufk firft with the fugar, then with the gum, and add the rofe-water by degrees.

This was intended as an improvement upon the hyfteric julep with mufk of Bates.

LAC AMYGDALÆ.
Lond.
Almond Milk.

Take of
 Sweet almonds, one ounce and an half;

Double-refined ſugar, half an ounce;
Diſtilled water, two pints.

Beat the almonds with the ſugar; then rubbing them together, add by degrees the water, and ſtrain the liquor.

EMULSIO COMMUNIS.

Edinb.

Common Emulſion.

Take of
Sweet almonds, one ounce;
Common water, two pounds and a half.

Beat the blanched almonds in a ſtone mortar, and gradually pour on them the common water, working the whole well together; then ſtrain off the liquor.

EMULSIO ARABICA.

Edinb.

Arabic Emulſion.

This is made in the ſame manner as the preceding; only adding, while beating the almonds,
Mucilage of gum arabic, two ounces.

These liquors are principally uſed for diluting and obtunding acrimonious humours, particularly in heat of urine and ſtranguries ariſing either from a natural ſharpneſs of the juices, or from the operation of cantharides, and other irritating medicines: in theſe caſes they are to be drunk frequently, to the quantity of half a pint or more at a time.

EMULSIO CAMPHORATA.

Edinb.

Camphorated Emulſion.

Take of
Camphor, one ſcruple;
Sweet almonds, blanched, ten;
Double-refined ſugar, one dram;
Water, ſix ounces.

This is to be made in the ſame manner as the common emulſion.

This is a much better preparation for exhibiting camphor in a liquid form than the *miſtura camphorata.*

LAC AMMONIACI.

Lond.

Ammoniacum Milk.

Take of
Ammoniacum, two drams;
Diſtilled water, half a pint.

Rub the gum-resin with the water, gradually poured on, until it becomes a milk.

In the same manner may be made a milk of asafœtida, and of the rest of the gum-resins.

The ammoniacum milk is used for promoting expectoration, in humoral asthmas, and coughs. It may be given to the quantity of two spoonfuls twice a day.

SPIRITUS ÆTHERIS VITRIOLICI COMPOSITUS.
Lond.
Compound Spirit of Vitriolic Ether.

Take of
 Spirit of vitriolic ether, two pounds;
 Oil of wine, three drams.
Mix them.

This has been highly extolled as an anodyne and antispasmodic medicine; and with these intentions it is frequently employed in medicine.

SPIRITUS AMMONIÆ COMPOSITUS.
Lond.
Compound Spirit of Ammonia.

Take of
 Spirit of ammonia, two pints;
 Essential oil of lemon,
 ———— nutmeg, of each two drams.
Mix them.

SPIRITUS AMMONIÆ AROMATICUS, *vulgo* SPIRITUS SALINUS AROMATICUS.
Edinb.
Aromatic Spirit of Ammonia, commonly called *Saline Aromatic Spirit.*

Take of
 Spirit of ammonia, eight ounces;
 Distilled oil of rosemary, one dram and a half.
 Distilled oil of lemon-peel, one dram.
Mix them, that the oils may be dissolved.

The dose is from five or six drops to sixty or more.

SPIRITUS AMMONIÆ SUCCINATUS.
Lond.
Succinated Spirit of Ammonia.

Take of
 Alcohol, one ounce;

Water of pure ammonia, four ounces by meaſure;
Rectified oil of amber, one ſcruple;
Sope, ten grains.
Digeſt the ſope and oil of amber in the alcohol till they be diſſolved; then add the water of pure ammonia, and mix them by ſhaking.

The *eau de luce* is not only uſed with the view of making an impreſſion on the noſe, but is taken internally in the ſame caſes of weakneſs and fainting. It has likewiſe of late been celebrated as a remedy for the bite of the rattle-ſnake, when uſed internally, and applied externally to the wounded part.

SPIRITUS CAMPHORATUS.

Lond.

Camphorated Spirit.

Take of
Camphor, four ounces;
Rectified ſpirit of wine, two pints.
Mix them, ſo that the camphor may be diſſolved.

SPIRITUS VINOSUS CAMPHORATUS.

Edinb.

Camphorated Spirit of Wine.

Take of
Camphor, one ounce;
Rectified ſpirit of wine, one pound.
Mix them together, that the camphor may be diſſolved.
It may alſo be made with a double, triple, &c. proportion of camphor.

Theſe ſolutions of camphor are employed chiefly for external uſes, againſt rheumatic pains, paralytic numbneſſes, inflammations, for diſcuſſing tumours, preventing gangrenes, or reſtraining their progreſs.

OLEUM CAMPHORATUM.

Edinb.

Camphorated Oil.

Take of
Freſh olive oil, two ounces;
Camphor, half an ounce.
Mix them, ſo that the camphor may be diſſolved.

This is deſigned for external purpoſes, and is uſeful againſt burns, bruiſes, rheumatic pains, &c.

EMULSIO OLEOSA SIMPLEX.

Gen.

Simple Oily Emulsion.

Take of
Almond oil, one ounce;
Syrup of marshmallows, an ounce and a half;
Gum arabic, half an ounce;
Spring water, six ounces.
Mix, and make an emulsion according to art.

EMULSIO OLEOSA VOLATILIS.

Gen.

Volatile Oily Emulsion.

Take of
Almond oil, an ounce and a half;
Syrup of marshmallow, one ounce;
Gum arabic, half an ounce;
Volatile alkali, one dram;
Spring water, seven ounces.
Mix them according to art.

This is often advantageously employed in cases of cough, hoarseness, and similar affections.

JULAPIUM ACIDUM.

Gen.

Acid Julep.

Take of
Weak vitriolic acid, three drams;
Simple syrup, three ounces;
Spring water, two pounds.
Mix them.

In this state the vitriolic acid is sufficiently diluted to be taken with ease in considerable doses; and it may thus be advantageously employed in various affections.

JULAPIUM ÆTHEREUM.

Gen.

Ether Julep.

Take of
Pure vitriolic ether, two scruples;
Spring water, six ounces;
Refined sugar, half an ounce.
Mix them according to art.

JULAPIUM SUCCINATUM.

Gen.

Amber Julep.

Take of
- Tincture of amber, two drams;
- Refined sugar, half an ounce;
- Spring water, six ounces.

Mix them, according to art.

This mixture may often be advantageously employed for counteracting nervous affections, and answering those other purposes for which we have already mentioned that this article is had recourse to in practice.

MIXTURA SALINA.

Suec.

Saline Mixture, or Julep.

Take of
- Fixed vegetable alkali, three drams;
- River water, half a pound.

To this lixivium add,
- Lemon juice, half a pound, or as much as is sufficient to saturate the alkali;
- Syrup of black currants, one ounce.

This mixture is frequently prescribed in febrile diseases as a means of promoting a slight discharge by the surface: for where the skin is parched with great increased heat, it generally operates as a gentle diaphoretic. It often also promotes a discharge by urine, and is frequently employed to restrain vomiting.

SOLUTIO MINERALIS ARSENICI.

Mineral Solution of Arsenic.

Take of
- White arsenic, reduced to a subtile powder,
- Fixed vegetable alkali, each sixty-four grains;
- Distilled water, half a pint.

Put them into a florentine flask, and let this be placed in a sand-heat, so that the water may boil gently till the arsenic be completely dissolved; then add to the solution, when cold, half an ounce of spirit of lavender, and as much distilled water as to make the solution amount to a pint.

This mixture is given, according to the age and other circumstances of the patient, in doses of from two to

twenty drops, once, twice, or oftener, in the courſe of the day: and its uſe has been found to be attended with remarkable ſucceſs, although with ſome patients even very ſmall doſes have been found to excite ſevere vomiting.

External Applications.

For external uſes various combinations of the former claſſes of bodies are formed, and theſe conſiſt either in the diffuſion of ſuch bodies in water or oil.

Medicated Waters.

Medicated waters are ſolutions of earthy or metallic ſubſtances, uſed only for topical application, in the form of lotion, injection, or gargle.

AQUA ALUMINIS COMPOSITA.
Lond.
Compound Alum-Water.

Take of
Alum,
Vitriolated zinc, of each half an ounce;
Boiling diſtilled water, two pints.
Pour the water on the ſalts in a glaſs veſſel, and ſtrain.

This liquor is uſed for cleanſing and healing ulcers and wounds; and for removing cutaneous eruptions, the part being bathed with it hot three or four times a day.

AQUA CUPRI AMMONIATI.
Lond.
Water of Ammoniated Copper.

Take of
Lime-water, one pint;
Sal ammoniac, one dram.
Let them ſtand together, in a copper veſſel, till the ammonia be ſaturated with copper.

This water is at preſent pretty much uſed as a detergent of foul and obſtinate ulcers, and for taking away ſpecks or films in the eyes.

AQUA LITHARGYRI ACETATI COMPOSITA.
Lond.
Compound Water of Acetated Litharge.

Take of
Acetated water of litharge, two drams;

Distilled water, two pints;
Proof-spirit, two drams.
Mix the spirit with the acetated water of litharge; then add the distilled water.

This liquor is of the same nature with the solution of *saccharum saturni*.

AQUA ZINCI VITRIOLATI CUM CAMPHORA.
Lond.
Water of Vitriolated Zinc with Camphor.

Take of
Vitriolated zinc, half an ounce;
Camphorated spirit, half an ounce by measure;
Boiling water, two pints.
Mix, and filter through paper.

This is used externally as a lotion for some ulcers, particularly those in which it is necessary to restrain a great discharge.

AQUA ZINCI VITRIOLATA, *vulgo* AQUA VITRIOLICA.
Edin.
Vitriolated Water of Zinc, commonly called *Vitriolated Water.*

Take of
Vitriolated zinc, sixteen grains;
Water, eight ounces;
Diluted vitriolic acid, sixteen drops.
Dissolved the vitriolated zinc in the water, and then, adding the acid, strain through paper.

Where the eyes are watery or inflamed, this solution of vitriolated zinc is a very useful application.

In the combinations which form the various ointments, cerates and plasters, fixed oil is the substance which is the base of the whole; and it receives adhesion or consistence from a mixture with certain of the bitumens or wax.

Plasters.

In forming a plaster, a greater degree of consistence is required than in any other form, and it should remain solid when cold, and be soft and pliable on a moderate heat, so as to adhere to the body, as well as to the substance on which it is spread. The consistence, however,

varies ſomewhat with the part of the body, being firmer and more adheſive for applying to the extremities than elſewhere; two parts of oil and two of wax to one of powder, forms a plaſter of proper conſiſtence; and theſe proportions may be varied according to the firmneſs required.

Plaſters are often impregnated with vegetable ſubſtances by boiling, but no particular advantage is derived from this addition. They are more properly united with lead, by which their conſiſtence is improved, and a proportion of warm water ſhould be added during the boiling.

EMPLASTRUM AMMONIACI CUM HYDRARGYRO.

Lond.

Ammoniacum Plaſter with Quickſilver.

Take of

Strained ammoniacum, one pound;
Purified quickſilver, three ounces;
Sulphurated oil, one dram, or what is ſufficient.

Rub the quickſilver with the ſulphurated oil until the globules diſappear; then add, by a little at a time, the melted ammoniacum, and mix them.

This is a very well contrived mercurial plaſter. The ammoniacum in general affords a good baſis for the application of the mercury.

EMPLASTRUM CANTHARIDIS.

Lond.

Plaſter of Spaniſh Flies.

Take of

Spaniſh flies, finely powdered, one pound;
Plaſter of wax, two pounds;
Prepared hog's lard, half a pound.

Having melted the plaſter and lard, a little before they coagulate ſprinkle in the flies, reduced to a very fine powder.

EMPLASTRUM CANTHARIDUM, *vulgo* VESICATORIUM.

Edin.

Plaſter of Spaniſh Flies, commonly called Bliſtering Plaſter.

Take of

Hog's lard,
Yellow wax,
White reſin,
Cantharides, each equal weights.

Beat the cantharides into a fine powder, and add them to the other ingredients, previously melted, and removed from the fire.

Both these formulæ are very well suited to excite blisters.

EMPLASTRUM CERÆ COMPOSITUM.

Lond.

Compound Wax-Plaster.

Take of
 Yellow wax,
 Prepared mutton-suet, of each three pounds ;
 Yellow resin, one pound.
Melt them together, and strain the mixture whilst it is fluid.

EMPLASTRUM SIMPLEX, *sive* EMPLASTRUM CEREUM.

Edinb.

Simple, or Wax-Plaster.

Take of
 Yellow wax, three parts ;
 Mutton suet,
 White resin, each two parts.
Melt them together into a plaster.

This plaster had formerly the title of *emplastrum attrahens*, and was chiefly employed as a dressing after blisters, to support some discharge.

EMPLASTRUM CUMINI.

Lond.

Cummin Plaster.

Take of
 Cummin seeds,
 Carraway seeds,
 Bay-berries, of each three ounces ;
 Burgundy pitch, three pounds ;
 Yellow wax, three ounces.
Melt the pitch and wax together, and mix with them the rest of the ingredients, powdered, and make a plaster.

This plaster stands recommended as a moderately warm discutient ; and is directed by some to be applied to the hypogastric region, for strengthening the viscera, and expelling flatulencies.

EMPLASTRUM ASÆFOETIDÆ, *vulgo* EMPLASTRUM ANTIHYSTERICUM.

Edinb.

Plaster of Asafœtida, commonly called *Antihysteric Plaster.*

Take of
Litharge plaster,
Asafœtida, strained, each two parts;
Yellow wax,
Strained galbanum, each one part.
Mix them melted with a gentle heat, and make them into a plaster.

This plaster is applied to the umbilical region, or over the whole abdomen, in hysteric cases; and sometimes with good effect.

EMPLASTRUM LADANI COMPOSITUM.

Lond.

Compound Ladanum Plaster.

Take of
Ladanum, three ounces;
Frankincense, one ounce;
Cinnamon, powdered,
Expressed oil of mace, of each an ounce;
Essential oil of mint, one dram.
To the melted frankincense add first the ladanum, softened by heat; then the oil of mace. Mix these afterwards with the cinnamon and oil of mint, and beat them together, in a warm mortar, into a plaster. Let it be kept in a close vessel.

This has been considered as a very elegant stomach-plaster.

EMPLASTRUM LITHARGYRI.

Lond.

Litharge Plaster.

Take of
Litharge, in very fine powder, five pounds;
Olive oil, a gallon;
Water, two pints.
Boil them with a slow fire, constantly stirring until the oil and litharge unite, and have the consistence of a plaster. It will be proper to add more boiling water, if the water that was first added be nearly consumed before the end of the process.

EMPLASTRUM LITHARGYRI, *vulgo* EMPLASTRUM COMMUNE.

Edinb.

Litharge Plaster, commonly called *Common Plaster*.

Take of
Litharge, one part;
Oil of olive, two parts.
Boil them, adding water, and constantly stirring the mixture till the oil and litharge be formed into a plaster.

These plasters, which have long been known under the name of *diachylon*, are the common application in excoriations of the skin, slight flesh wounds, and the like.

EMPLASTRUM LITHARGYRI COMPOSITUM.

Lond.

Compound Litharge Plaster.

Take of
Litharge-plaster, three pounds;
Strained galbanum, eight ounces;
Turpentine, ten drams;
Frankincense, three ounces.
The galbanum and turpentine being melted with a slow fire, mix with them the powdered frankincense, and afterwards the litharge-plaster melted with a very slow fire, and make a plaster.

EMPLASTRUM GUMMOSUM.

Edinb.

Gum Plaster.

Take of
Litharge plaster, eight parts;
Gum ammoniac, strained,
Strained galbanum,
Yellow wax, each one part.
Melt them together, and make them into a plaster.

Both these plasters are used as digestives and suppuratives.

EMPLASTRUM LITHARGYRI CUM HYDRARGYRO.

Lond.

Litharge Plaster with Quicksilver.

Take of
Litharge-plaster, one pound;

Purified quickfilver, three ounces;
Sulphurated oil, one dram, or what is fufficient.

Make the plfter in the fame manner as the ammoniacum-plafter with quickfilver.

EMPLASTRUM HYDRARGYRI, *vulgo* CÆRULEUM.

Edinb.

Quickfilver or Mercurial Plafter, commonly called *Blue Plafter*.

Take of
Olive oil,
White refin, each one part;
Quickfilver, three parts;
Litharge plafter, fix parts.

Melt the oil and refin together, and when this mixture is cold, let the quickfilver be rubbed with it till the globules difappear; then add by degrees the litharge plafter, melted, and let the whole be accurately mixed.

These mercurial plafters are confidered as powerful refolvents and difcutients.

EMPLASTRUM LITHARGYRI CUM RESINA.

Lond.

Litharge Plafter with Refin.

Take of
Litharge plafter, three pounds;
Yellow refin, half a pound.

To the litharge plafter, melted with a very flow fire, add the powdered refin; mix them well, and make a plafter.

EMPLASTRUM RESINOSUM, *vulgo* EMPLASTRUM ADHÆSIVUM.

Edinb.

Refinous Plafter, commonly called *Sticking Plafter*.

Take of
Common plafter, five parts;
White refin, one part,

Melt them together, and make a plafter.

Thefe plafters are chiefly ufed as adhefives for keeping on other dreffings.

EMPLASTRUM PICIS BURGUNDICÆ COMPOSITUM.

Lond.

Compound Burgundy-Pitch Plafter.

Take of
Burgundy pitch, two pounds

Ladanum, one pound;
Yellow resin,
Yellow wax, of each four ounces;
Expressed oil of mace, one ounce.
To the pitch, resin, and wax, melted together, add first the ladanum, and then the oil of mace.

This plaster is applied in weakness or pains of the head, to the temples, forehead, &c. and sometimes likewise to the feet.

EMPLASTRUM SAPONIS.

Lond.

Sope Plaster.

Take of
Sope, half a pound;
Litharge plaster, three pounds.
Mix the sope with the melted litharge-plaster, and boil them to the thickness of a plaster.

EMPLASTRUM SAPONACEUM.

Edinb.

Saponaceous Plaster.

Take of
Litharge plaster, four parts;
Gum plaster, two parts;
Castile sope, scraped, one part.
To the plasters, melted together, add the sope; then boil for a little, so as to form a plaster.

These plasters have been supposed to derive a resolvent power from the sope.

EMPLASTRUM THURIS COMPOSITUM.

Lond.

Compound Frankincense Plaster.

Take
Frankincense, half a pound;
Dragon's blood, three ounces;
Litharge plaster, two pounds.

This plaster had formerly in the London pharmacopœia the title of *emplastrum roborans.* Though far the most elegant and simple, it is as effectual for that purpose as any of the medicines of this kind.

EMPLASTRUM LITHARGYRI COMPOSITUM, *vulgo* EMPLASTRUM ROBORANS.

Edinb.

Compound Litharge-Plaster, commonly called *Strengthening Plaster.*

Take of
  Litharge plaster, twenty-four parts;
  White resin, six parts;
  Yellow-wax,
  Oil of olive, each three parts.
  Burnt vitriolated iron, eight parts.
Grind the colcothar with the oil, and then add it to the other ingredients previously melted.

This plaster is laid round the lips of wounds and ulcers over the other dressings, for defending them from inflammation and a fluxion of humours.

EMPLASTRUM *de* BELLADONNA.

Brun.

Deadly Nightshade Plaster.

Take of
  The juice of the recent herb of belladonna,
  Lintseed oil, each nine ounces;
  Yellow wax, six ounces;
  Venice turpentine, six drams;
  Powder of the herb of belladona, two ounces.
Let them be formed into a plaster according to art.

There can be no doubt that the belladonna, externally applied, has a very powerful influence, both on the nerves and blood-vessels of the part; and thus it has very considerable effect both on the circulation and state of sensibility of the part.

EMPLASTRUM *ad* CLAVOS PEDUM.

Dan.

Corn Plaster.

Take of
  Galbanum, dissolved in vinegar, and again inspissated, one ounce;
  Pitch, half an ounce;
  Diachylon, or common plaster, two drams.
Let them be melted together; and then mix with them
  Verdegris, powdered,
  Sal ammoniac, each one scruple;
And make them into a plaster.

This plaster has been celebrated for the removal of corns, and for alleviating the pain which they occasion.

EMPLASTRUM è CONIO.

Suec.

Hemlock Plaster.

Take of
Yellow wax, half a pound;
Olive oil, four ounces;
Gum ammoniac, half an ounce;
After they are melted together, mix with them
Powdered herb of hemlock, half a pound.

This plaster appears very well contrived, and the additional ingredients well chosen for assisting the efficacy of the hemlock.

EMPLASTRUM CORROSIVUM.

Gen.

Corrosive Plaster.

Take of
Corrosive sublimate of mercury, half a dram;
Hog's lard, half an ounce;
Yellow wax, two drams.
Mix them according to art.

There can be no doubt that the hydrargyrus muriatus here employed is a very powerful corrosive; and there may be some cases in which it is preferable to other articles of the tribe of caustics.

EMPLASTRUM è FOENUGRÆCO, *vulgo de* MUCILAGINIBUS.

Gen.

Plaster of Fenugreek, or of Mucilages.

Take of
Fenugreek-seed, two ounces;
Lintseed-oil, warm, half a pound.
Infuse them according to art, and strain; then,
Take of
Yellow wax, two pounds, and a half;
Gum ammoniac, strained, six ounces;
Turpentine, two ounces.

Melt the gum ammoniacum with the turpentine, and by degrees add the oil and wax melted in another vessel, so as to form a plaster.

This plaster, although still in esteem by some, is probably of no great value.

EMPLASTRUM *ex* HYOSCYAMO.

Suec.

Henbane Plaster.

This is directed to be prepared in the same manner as the emplastrum è conio, or hemlock plaster.

From the well known sedative power of this plant, as affecting the nervous energy of the part to which it is applied, we might reasonably conclude that good effects may be obtained from it when used under the form of plaster.

EMPLASTRUM PICEUM.

Ross.

Pitch Plaster.

Take of
White resin, six ounces;
Ship pitch, seven ounces;
Yellow wax, five ounces.
Melt them, and form them into a plaster.

Pitch, applied externally, has been supposed to act on two principles, by its warmth and by its adhesive quality; particularly it has thus been found to produce a cure in cases of tinea capitis.

Ointments and Liniments.

Ointments are plaisters of a less firm consistence, and by reducing a plaister by a greater addition of oil, to the consistence of honey, an ointment is formed by the farther addition a liniment.

In making ointments the fat and wax should first be melted by a gentle heat, then constantly stirred, and the dry ingredients sprinkled in indiscriminately till by heat the mixture experiences consistence.

UNGUENTUM ADIPIS SUILLÆ.

Lond.

Ointment of Hog's Lard.

Take of
Prepared hog's lard, two pounds;
Rose water, three ounces.

Beat the lard with the rose-water until they be mixed; then melt the mixture with a slow fire, and set it apart that the water may subside: after which pour off the lard from the water, constantly stirring until it be cold.

UNGUENTUM SIMPLEX.

Edinb.

Simple Ointment.

Take of
Olive oil, five parts;
White wax, two parts.

Both these ointments may be used for softening the skin and healing chaps. The last is, however, preferable, as being more steadily of one uniform consistence.

UNGUENTUM *ex* ÆRUGINE.

Edinb.

Ointment of Verdegris.

Take of
Resinous ointment, fifteen parts;
Verdegris, one part.

This ointment is used for cleansing sores, and keeping down fungous flesh. Where ulcers continue to run from a weakness in the vessels of the part, the tonic powers of copper promise considerable advantage.

UNGUENTUM CALCIS HYDRARGYRI ALBÆ.

Lond.

Ointment of white Calx of Quicksilver.

Take of
The white calx of quicksilver, one drachm;
Ointment of hog's lard, one ounce and a half.

Mix, and make an ointment.

This

This is a very elegant mercurial ointment, and frequently made use of in the cure of obstinate cutaneous affections.

UNGUENTUM è CALCE ZINCI.

Edinb.

Ointment of Calx of Zinc.

Take of
Simple liniment, six parts;
Flowers of zinc, one part.

This ointment is chiefly used in affections of the eye, particularly in those cases where redness arises rather from relaxation than from active inflammation.

UNGUENTUM CANTHARIDIS.

Lond.

Ointment of the Spanish Flies.

Take of
Spanish flies, powdered, two ounces;
Distilled water, eight ounces;
Ointment of yellow resin, eight ounces.

Boil the water with the Spanish flies to one half, and strain. To the strained liquor add the ointment of yellow resin. Evaporate this mixture in a water bath, saturated with sea-salt, to the thickness of an ointment.

UNGUENTUM EPISPASTICUM *ex* INFUSIONE CANTHARIDUM.

Edinb.

Epispastic Ointment from Infusion of Cantharides.

Take of
Cantharides,
White resin,
Yellow wax, each one ounce;
Hog's lard,
Venice turpentine, each two ounces;
Boiling water, four ounces.

Infuse the cantharides in the water, in a close vessel, for a night; then strongly press out and strain the liquor, and boil it with the lard till the water be consumed; then add the resin, wax, and turpentine, and make the whole into an ointment.

These ointments, containing the soluble parts of the cantharides, uniformly blended with the other ingredi-

ents, are more commodious, and in general occasion less pain, though not less effectual with this intention than the compositions with the fly in substance.

UNGUENTUM EPISPASTICUM è PULVERI CANTHARIDUM.

Epispastic Ointment, from Powder of Cantharides.

Edinb.

Take of

Resinous ointment, seven parts;
Powdered cantharides, one part.

This ointment is employed in the dressings for blisters intended to be made perpetual, as they are called, or to be kept running for a considerable sime, which in many chronic, and some acute cases, is of great service.

UNGUENTUM CERÆ.

Lond.

Wax Ointment.

Take of

White wax, four ounces;
Spermaceti, three ounces;
Olive oil, one pint.

Stir them, after being melted with a slow fire, constantly and briskly until cold.

This ointment had formerly the title of

UNGUENTUM CERUSSÆ ACETATÆ.

Lond.

Ointment of acetated Ceruse.

Take of

Acetated ceruse, two drams;
White wax, two ounces;
Olive-oil, half a pint.

Rub the acetated ceruse, previously powdered, with some part of the olive-oil; then add it to the wax, melted with remaining oil. Stir the mixture until it be cold.

UNGUENTUM SATURNINUM.

Edin.

Saturnine Ointment.

Take of

Simple ointment, twenty parts;
Sugar of lead, one part.

Both these ointments are useful coolers and deficcatives.

UNGUENTUM è CERUSSA *vulgo* ALBUM.

Edin.

Ointment of Ceruſſe, commonly called *White Ointment.*

Take of
Simple ointment, five parts;
Ceruſſe, one part.

This is an uſeful, cooling, emollient ointment, in great ſervice in excoriations and other ſimilar frettings of the ſkin.

UNGUENTUM ELEMI.

Lond.

Ointment of Elemi.

Take of
Elemi, one pound;
Turpentine, ten ounces;
Mutton ſuet, prepared, two pounds;
Olive oil, two ounces.
Melt the elemi with the ſuet; and, having removed it from the fire, mix it immediately with the turpentine and oil, after which ſtrain the mixture.

This ointment, perhaps beſt known by the name of Arcaus's Liniment, has long been in uſe for digeſting, cleanſing, and incarnating.

UNGUENTUM HELLEBORI ALBI.

Lond.

Ointment of white Hellebore.

Take of
The root of white hellebore, powdered, one ounce
Ointment of hog's lard, four ounces;
Eſſence of lemons, half a ſcruple.
Mix them, and make an ointment.

White hellebore externally applied has long been celebrated in the cure of cutaneous affections.

UNGUENTUM HYDRARGYRI FORTIUS.

Lond.

Stronger Ointment of Quickſilver.

Take of
Purified quickſilver, two pounds;
Hog's lard, prepared, twenty-three ounces;
Mutton ſuet, prepared, one ounce.
Firſt rub the quickſilver with the ſuet and a little of the hog's lard, until the globules diſappear; then add what remains of the lard, and make an ointment.

UNGUENTUM HYDRARGYRI MITIUS.

Lond.

Weaker Ointment of Quickſilver.

Take of
The ſtronger ointment of quickſilver, one part;
Hog's lard, prepared, two parts.
Mix them.

UNGUENTUM *ex* HYDRARGYRO, *ſive* CÆRULEUM.

Edinb.

Quickſilver, or *Blue Ointment.*

Take of
Quickſilver,
Mutton ſuet, each one part;
Hog's lard, three parts.
Rub them carefully in a mortar till the globules entirely diſappear.

These ointments are principally employed, not with a view to their topical action, but with the intention of introducing mercury in an active ſtate into the circulating ſyſtem.

UNGUENTUM HYDRARGYRI NITRATI.

Lond.

Ointment of nitrated Quickſilver.

Take of
Purified quickſilver, one ounce;
Nitrous acid, two ounces;
Hog's lard, prepared, one pound.
Diſſolve the quickſilver in the nitrous acid; and, whilſt it is yet hot mix it with the hog's lard, previouſly melted, and now growing cold.

UNGUENTUM CITRINUM.

Edinb.

Yellow Ointment.

Take of
Quickfilver, one ounce;
Spirit of nitre, two ounces;
Hog's lard, one pound.

Diffolve the quickfilver in the fpirit of nitre, by digeftion in a fand heat; and, whilft the folution is very hot, mix with it the lard, previoufly melted by itfelf, and juft beginning to grow ftiff. Stir them brifkly together, in a marble mortar, fo as to form the whole into an ointment.

This affords us a very active ointment; and as fuch it is frequently employed with fuccefs in cutaneous and other topical affections.

UNGUENTUM PICIS.

Lond.

Tar Water.

Take of
Tar,
Mutton-fuet, prepared, of each half a pound.

Melt them together, and ftrain.

UNGUENTUM È PICE.

Edinb.

Ointment of Tar.

Take of
Tar, five parts;
Yellow wax, two parts.

This has been fuccefsfully employed againft fome cutaneous affections, particularly thofe of domeftic animals. At one time, as well as the black bafilicon, it was a good deal employed as a dreffing even for recent wounds.

UNGUENTUM RESINÆ F).A

Lond.

Ointment of yellow Rofin

Take of
Yellow refin,

Yellow wax, of each one pound;
Olive oil, one pint.

Melt the resin and wax with a slow fire; then add the oil, and strain the mixture whilst hot.

UNGUENTUM BASILICUM FLAVUM.

Edinb.

Yellow Basilicon Ointment.

Take of
Hog's lard, eight parts;
White resin, five parts;
Yellow wax, two parts.

These are commonly employed in dressings, for digesting, cleansing, and incarnating wounds and ulcers.

UNGUENTUM SAMBUCI.

Lond.

Elder Ointment.

Take of
Elder flowers, four pounds;
Mutton suet, prepared, three pounds;
Olive oil, one pint.

Boil the flowers in the suet and oil, first melted together, till they be almost crisp; then strain with expression.

This ointment does not seem superior to some others which are much neater, and preparable at less expence.

UNGUENTUM SPERMATIS-CETI.

Lond.

Ointment of Spermaceti.

Take of
Spermaceti, six drams;
White wax, two drams;
Olive oil, three ounces.

Melt them together, over a slow fire, stirring them constantly and briskly until they be cold.

This had formerly the name of the White Liniment, and it is perhaps only in consistence that it can be considered as differing from the Unguentum Simplex.

UNGUENTUM SULPHURIS.

Lond.

Sulphur Ointment.

Take of
Ointment of hog's lard, half a pound;
Flowers of sulphur, four ounces.
Mix them, and make an ointment.

UNGUENTUM è SULPHURE, *five* ANTIPSORICUM.

Edin.

Ointment of Sulphur, or Antipsoric Ointment.

Take of
Hog's lard, four parts;
Sulphur, beat into a very fine powder, one part.
To each pound of this ointment add,
Essence of lemons, or
Oil of lavender, half a dram.

Sulphur is a certain remedy for the itch, more safe than mercury.

UNGUENTUM TUTIÆ.

Lond.

Tutty Ointment.

Take of
Prepared tutty, one dram;
Ointment of spermaceti, what is sufficient.
Mix them so as to make a soft ointment.

UNGUENTUM è TUTIA.

Edin.

Ointment of Tutty.

Take of
Simple liniment, five parts;
Prepared tutty, one part.

These ointments have long been celebrated, and are still much employed against affections of the eyes. But they cannot, we imagine, be esteemed elegant.

LINIMENTUM SIMPLEX.

Edin.

Simple Liniment.

Take of
Olive oil, four parts;
White wax, one part.

This consists of the same articles which form the Unguentum Simplex.

LINIMENTUM AMMONIÆ.

Lond.

Liniment of Ammonia,

Take of
Water of ammonia, half an ounce;
Olive oil, one ounce and a half.
Shake them together in a phial, till they are mixed.

This has long been known in the shops under the title of Linimentum Volatile.

LINIMENTUM AMMONIÆ FORTIUS.

Lond.

Stronger Liniment of Ammonia.

Take of
Water of pure ammonia, one ounce;
Olive oil, two ounces.
Shake them together in a phial.

This article differs from the foregoing only in strength.

LINIMENTUM CAMPHORÆ.

Lond.

Camphor Liniment.

Take of
Camphor, two ounces;
Water of ammonia, six ounces;
Simple spirit of lavender, sixteen ounces.
Mix the water of ammonia with the spirit, and distil from a glass retort, with a slow fire, sixteen ounces. Then dissolve the camphor in the distilled liquor.

LINIMENTUM SAPONIS.

Lond.

Soap Liniment.

Take of
Soap, three ounces;
Camphor, one ounce;
Spirit of rosemary, one pint.

Digest the soap in the spirit of rosemary until it be dissolved, and add to it the camphor.

This, though a less active and penetrating application than the preceding, is perhaps no less useful; and it is often successfully employed for external purposes against rheumatic pains, sprains, bruises, and similar complaints.

UNGUENTUM ÆGYPTIACUM.

Gen.

Ægyptian Ointment.

Take of
Honey, one pound;
Strong vinegar, half a pound;
Verdegris, powdered, five ounces.

Let the ingredients be boiled together till the verdegris be dissolved, so that the ointment may have a due degree of thickness and a purple colour.

This preparation had formerly a place in our pharmacopœia's under the title of Mel Ægyptiacum.

UNGUENTUM ANODYNUM.

Gen.

Anodyne Ointment.

Take of
Olive oil, ten drams;
Yellow wax, half an ounce;
Crude opium, one dram.

Mix them according to art, so as to form an ointment.

Opium, thus externally applied, will in some degree be productive of the same effect as when used under the form of the anodyne balsam.

UNGUENTUM *ad* CANCRUM EXULCERATUM.

Brun.

Ointment for an ulcerated Cancer.

Take of
The recently expressed juice of the ricinus, one pound
Let it be exposed to the rays of the sun in a leaden vessel till it acquire the consistence of an oil, then to one pound of this inspissated juice, add
Calcined lead,
White precipitate of mercury, each one pound.
Let them be properly mixed

This acrid application must possess a considerable degree of corrosive power. And in some cases of cancer, by the proper application of corrosives, much benefit may be done, provided their caustic quality is suited to the state of the sore.

UNGUENTUM DIGESTIVUM.

Ross.

Digestive Ointment.

Take of
Venice turpentine, one pound;
The yelks of eight eggs.
Mix them together, according to art.

This warm stimulating application is well suited to promote the superative inflammation.

UNGUENTUM HÆMORRHOIDALE.

Hæmorrhoidal Ointment.

Take of
Saturnine ointment, six drams;
Oil of hyoscyamus, obtained by boiling, two drams;
Camphor, powdered, two scruples,
Mix them into an ointment

The name affixed to this ointment expresses the purpose for which it is applied.

UNGUENTUM NERVINUM.

Suec.

Nervine Ointment.

Take of
Prepared mutton suet, eight ounces.

After it is melted and removed from the fire, add to it
Oil of bays, one pound;
Ætherial oil of turpentine, one ounce;
Rectified oil of amber, half an ounce.
Let them be mixed and rubbed together till they form an ointment.

It furnishes a warm stimulating nervine application, which may be in some degree instrumental in restoring sense and motion to paralytic limbs.

UNGUENTUM *de* NICOTIANA.

Dan.

Ointment of Tobacco.

Take of
The leaves of tobacco, cut down, three pounds;
Juice of tobacco, nine ounces;
Hog's lard, a pound and a half.
Let them be macerated for the space of a night, and then boiled over a gentle fire till the humidity be consumed. Having strained the fluid obtained by expression, add to it
Resin, three ounces;
Yellow wax, half an ounce;
Powder of the root of birthwort, three ounces.
Mix them into an ointment.

It has been found, under proper management, to afford an effectual cure in obstinate cutaneous affections.

UNGUENTUM *è* STYRACE.

Suec.

Ointment of Storax.

Take of
Olive oil, a pound and a half;
White resin,
Gum elemi,
Yellow wax, each seven ounces.
After they are melted together and strained, add
Liquid storax, seven ounces.
Mix them together, and agitate the mixture till it concretes into an uniform ointment.

It has been much celebrated not only as a strengthening application to weakly children, but even for the removal of affections of the bones, as in cases of rachitis and the like.

UNGUENTUM SUPPURANS.

Suec.

Suppurative Ointment.

Take of
  Yellow wax,
  Refin, each half a pound.
To thefe melted, add
  Onion roafted under the afhes;
  Honey, each two pounds and a half;
  Black foap, half a pound.
Let them be gently boiled together till all the moifture be confumed, then ftrain the liquor, expreffing it from the materials, and afterwards agitate it with a wooden peftle that it may unite into one uniform mafs.

This ointment is applied with the intention of promoting fuppuration.

It may fupply the place either of the bliftering plafter or ointment; and there are cafes in which it is preferable to either.

Cerates

Form an intermediate confiftence between the plafter and ointment, and therefore require no feparate confideration.

CERATUM SIMPLEX.

Edin.

Simple Cerate.

Take of
  Olive oil, fix parts;
  White wax, three parts;
  Spermaceti one part
Unite them according to art.

This differs from the fimple ointment in containing a greater proportion of wax to the oil.

CERATUM CANTHARIDIS.

Lond.

Cerate of Cantharides, or Spanifh Flies.

Take of
  Cerate of fpermaceti, foftened with heat, fix drams;

Spanish flies, finely powdered, one dram.
Mix them.

Under this form cantharides may be made to act to any extent that is requisite.

CERATUM LAPIDIS CALAMINARIS.

Lond.

Calamine Cerate.

Take of
Calamine, prepared,
Yellow wax, of each half a pound;
Olive oil, one pint.
Melt the wax with the oil, and, as soon as the mixture begins to thicken, mix with it the calamine, and stir the cerate until it be cold.

CERATUM è LAPIDE CALAMINARI.

Edin.

Cerate of Calamine.

Take of
Simple cerate, five parts;
Calamine prepared, one part.

These compositions are formed upon the cerate which Turner strongly recommends in cutaneous ulcerations and excoriations.

CERATUM LITHARGYRI ACETATI.

Lond.

Cerate of acetated Litharge.

Take of
Water of acetated litharge, two ounces and an half;
Yellow wax, four ounces,
Olive oil, nine ounces,
Camphor, half a dram
Rub the camphor with a little of the oil. Melt the wax with the remaining oil, and as soon as the mixture begins to thicken, pour in by degrees the water of acetated litharge, and stir constantly until it be cold; then mix in the camphor before rubbed with the oil.

This application has been rendered famous by the recommendation of Mr. Goulard.

CERATUM RESINÆ FLAVÆ.

Lond.

Cerate of yellow Resin.

Take of
Ointment of yellow resin, half a pound;
Yellow wax, one ounce.
Melt them together, and make a cerate.

This had formerly the name of *Unguentum Citrinum.* It is in no other respect different from the yellow basilicum, or Unguentum resinæ flavæ, than being of a stiffer consistence, which renders it for some purposes more commodious.

CERATUM SAPONIS.

Lond.

Soap Cerate.

Take of
Soap, eight ounces;
Yellow wax, ten ounces;
Litharge, powdered, one pound;
Olive oil, one pint
Vinegar, one gallon.
Boil the vinegar with the litharge, over a slow fire, constantly stirring until the mixture unites and thickens; then mix in the other articles, and make a cerate.

This, notwithstanding the name, may rather be considered as another saturnine application than one whose activity depends upon soap.

CERATUM SPERMATIS CETI.

Edinb.

Cerate of Spermaceti.

Take of
Spermaceti, half an ounce;
White wax, two ounces;
Olive oil, four ounces.
Melt them together, and stir until the cerate be cold.

This had formerly the name of *Ceratum Album*, and it differs in nothing from the Unguentum Spermatis ceti

CERATUM LABIALE.

Ross.

Lip Salve.

Take of
Olive oil, eighteen ounces;
White wax, one pound;
Spermaceti, an ounce and a half;
Oil of rhodium, half a dram.
Form a cerate, tinging it with alkanet, so as to give a red colour.

The name affixed to this cerate points out the use for which it is intended.

CEREI MEDICATI.

Suec.

Bougies.

Take of
Yellow wax, melted, one pound;
Spermaceti, three drams;
Vinegar of litharge, two drams.
Mix them, and upon removal from the fire immerse into the mixture slips of linen, of which bougies are to be formed according to the rules of art.
These may also be made with double, triple, or quadruple, the quantity of the vinegar.

Bougies are a preparation of great importance to the surgeons, and deserve, therefore, a place.

END OF THE THIRD VOLUME.

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